ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

JUNE 18, 1949

ELECTRICAL WORLD 1874 1949 OUR 75TH YEAR

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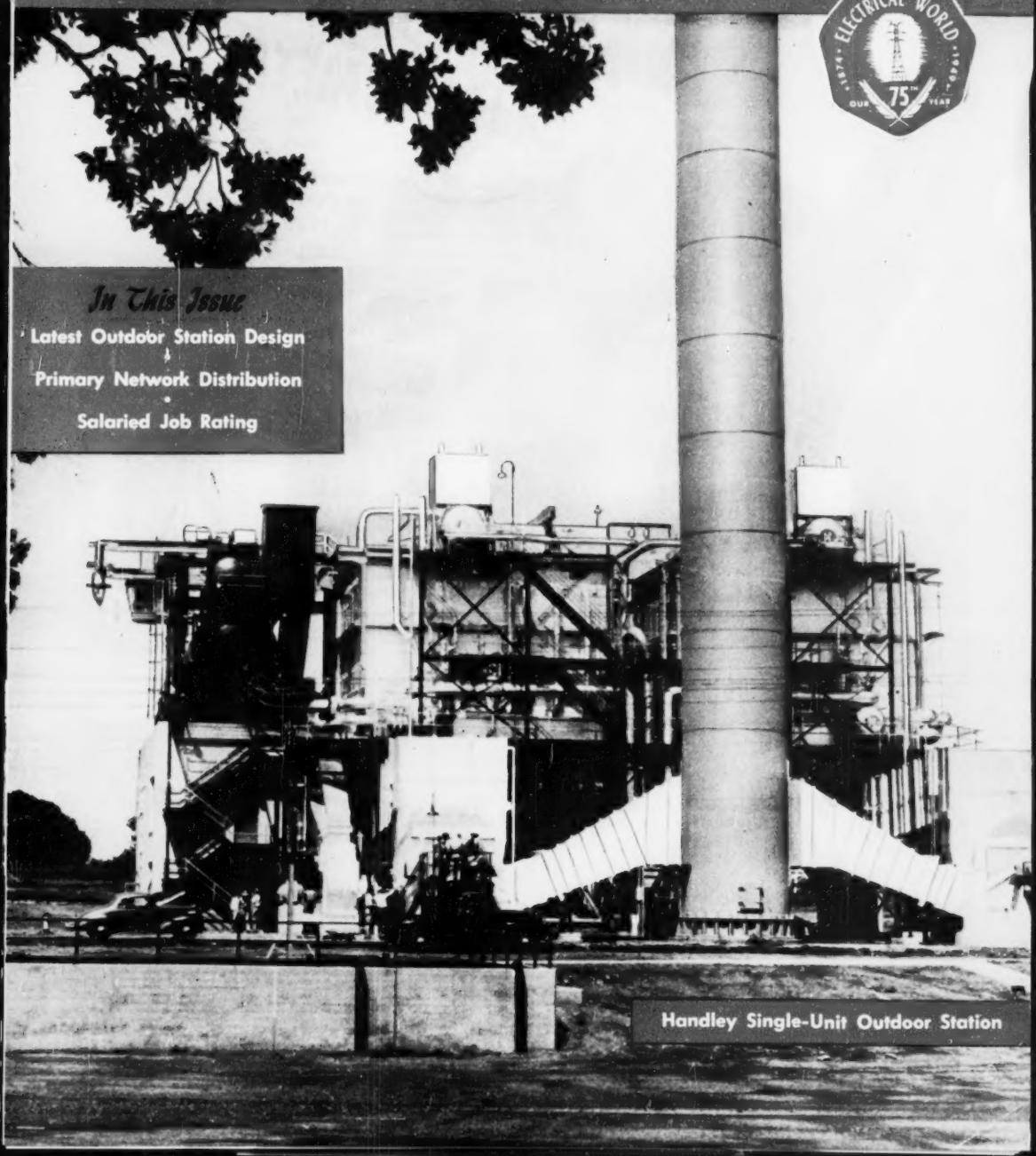
Latest Outdoor Station Design

Primary Network Distribution

Salaried Job Rating



Handley Single-Unit Outdoor Station

HERE'S THE NEW...

WESTON A-C Clamp-Ammeter and VOLTMETER

5 Current ranges to 1000 Amperes

3 Voltage ranges to 700 Volts

Voltage terminals recessed, with insulated screw-type connectors on leads.

Heavily insulated jaws accommodate conductors to 2" dia. (bare or insulated).

Pointer stop for indicating motor starting currents.

Trigger operation for convenience.

Ask your Weston representative for full particulars, or write... WESTON Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J.

WESTON *Instruments*

Albany • Atlanta • Boston • Buffalo • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Jacksonville • Knoxville • Little Rock • Los Angeles • Meriden • Minneapolis • Newark New Orleans • New York • Orlando • Philadelphia • Phoenix • Pittsburgh • Rochester • San Francisco • Seattle • St. Louis • Syracuse • Tulsa • In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.

ELECTRICAL WORLD

Published for 75 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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21 YEARS OF PROOF

Section of Okoloy-coated wire removed for examination after 13 years of service along railroad right of way, under continuous exposure to weather and highly corrosive sulphur fumes. Note perfect condition of Okoloy coating and Okonite insulation.

OKOLOY

COATINGS FOR CONDUCTORS

Outlast "TINNING" 2 to 1

. . . another reason why Okonite quality gives true cable economy!

TWENTY-ONE YEARS of repeated proof in severest service have borne out the original findings of Okonite research chemists—*that Okoloy coatings for copper conductors outlast "tinning" at least two to one.* Test after test shows that this quality feature adds years to the useful life of Okonite wires and cables.

The Okoloy process was introduced in 1928 to offset two factors frequently encountered in tin conductor-coatings which lessen long cable life—1) tin coatings readily alloy with copper in the processing bath and, as a result, some copper always remains in contact with the rubber insulation; and 2) the sulphur contained in the rubber compounds then reacts with and destroys the tin-copper coating which in turn exposes the copper conductor, eventually causing deterioration of the rubber insulation.

Okoloy affords protection against both these factors because it is a lead alloy. Of all common metals, lead is least damaged by sulphur acids. What's more, lead does not alloy with copper under the conditions encountered in coating conductors. Because processing baths are not contaminated with copper, the Okoloy coating is pure throughout. It adheres strongly to the copper conductor, and surrounds it with an acid-resistant, flexible coating which contributes materially to longer life of both rubber insulation and conductor.

Okoloy is just one of the "longer-life" features built into Okonite products—features that give true wire and cable economy, especially in these days of high installation costs. To get complete details on how Okonite can meet your needs, we suggest that you call in an Okonite engineer, or write to The Okonite Company, Passaic, N. J.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE insulated wires and cables

7593

Electroline Duct Rodding

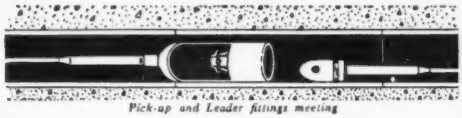
DOES IN THIRTY MINUTES WHAT USED TO TAKE TWO WEEKS

Utilities have found that one gang, with Electroline Steel Duct-Rodding Equipment, can make a half-hour job out of one that formerly took two gangs two weeks with old-style equipment!

In consequence, they have made amazing savings in labor cost alone. Add to this lower first cost, the lower handling cost, and longer life . . . then you have their reason for adopting Electroline's speedy, economical Duct-Rodding Equipment.

The construction is simple and trouble-free, yet affords the outstanding advantages of easy, efficient rodding and great durability in service.

Originated by Electroline—Always Ahead of the Field. Write for bulletins.



Pick-up and Leader fittings meeting

Right, Electroline Steel Rodding Equipment feeds easily around the bends.

Below, Leader locked in Pick-up for either push or pull.

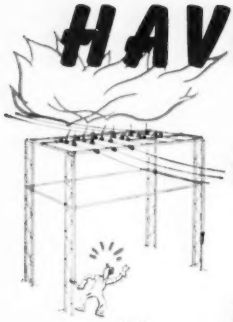
. PATENT APPLIED FOR

Electroline Company

4121 South La Salle Street
Chicago 9, Illinois

OTHER *Electroline* PRODUCTS

HAVE YOU SWITCHING

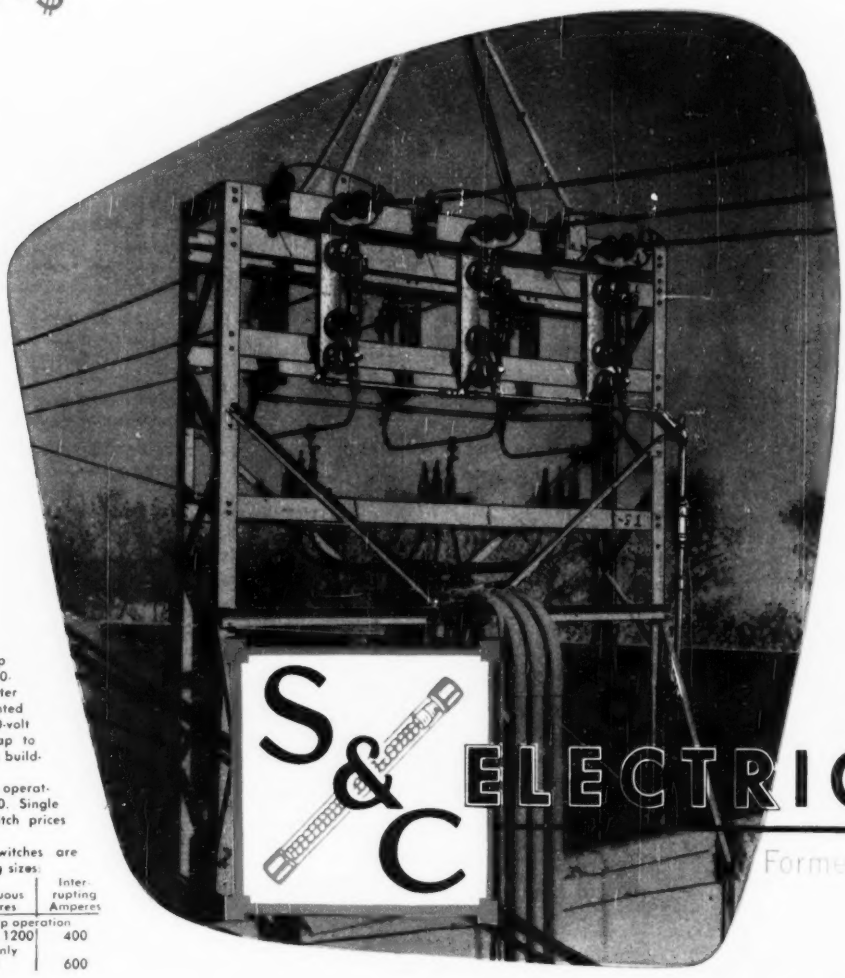


① Where Horn Gap Switches Are Inadequate

because they cannot, under all conditions, safely break magnetizing or charging currents; nor can they interrupt load currents

② Where Circuit Breakers Are Becoming Too Expensive

for non-automatic switching and short circuit protection



Two three-pole, group operated, 7,500-volt, 400-ampere, Alduti Interrupter Switches vertically mounted back to back, in 2,300-volt overhead loop circuit tap to load center substation in building below.

Price each, including operating mechanism, $490.00. Single pole stick operated switch prices as low as $65.00.

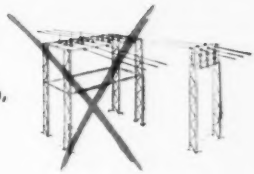
Alduti Interrupter Switches are supplied in the following sizes:

Volts	Continuous Amperes	Interrupting Amperes
For hook stick or group operation		
7500 & 15000	400, 600, 1200	400
For group operation only		
23000 & 34500	600	600

APPLICATIONS . . . . .

③ Where Structure Design Is Restricted

because horn gap switches can be mounted only in the horizontal upright position, need wide phase spacings, and always require an operating mechanism



④ Where Switching Sequences Are Too Complicated And Costly

because multiple operations—involving breakers, disconnects, and operating personnel—are required to isolate equipment or sectionalize circuits

ALDUTI INTERRUPTER SWITCHES

offer a proved and economical solution to such application problems.

Ten years of actual operating experience in thousands of installations, and many field trials under inordinately severe test conditions, have demonstrated convincingly the ability of these Interrupters to—safely and repeatedly—

Sectionalize either radial or loop distribution and subtransmission circuits, under either load or charging current conditions . . .

Switch load and magnetizing currents of transformer banks . . .

Switch charging currents of capacitor banks.

Because there is NO EXTERNAL ARCING during the operation of Alduti Interrupters: they need not be mounted only horizontally upright, but can also be mounted vertically, or horizontally underhung; hook stick operation can be employed where economy dictates; and phase spacings can be reduced to 18 inches for the 7,500-volt and 39 inches for the 34,500-volt switches. Hence structures can be smaller, connections simpler, and construction cost can be reduced below that of installing horn gap switches. Also, Alduti Interrupters can be installed in cubicles, thus providing—even for subtransmission applications—enclosed "packaged-type" switches, thereby permitting the complete enclosure of all components of a unit-type substation.

When combined with S & C Power Fuses, Alduti Fused Interrupters also provide short circuit protection with fault current interrupting ability up to 40,000 amperes asymmetrical, thus making possible the elimination of expensive circuit breakers where automatic switching is not required.

OPERATING, CONSTRUCTION, AND MOUNTING DETAILS, INTERRUPTING RATINGS, AND FIELD TEST REPORTS WILL BE MAILED ON REQUEST

S & C ELECTRIC COMPANY
4421 Ravenswood Avenue
Chicago 40, Illinois

☐ Please send complete information on ..... 7.5 kv, ... 15 kv, ... 23 kv, ... 34.5 kv Alduti Interrupter Switches

☐ Have representative call

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City ..... Zone ..... State .....

COMPANY

SCHWEITZER & CONRAD, INC.

Report to Power Engineers

Production of New Standardized Switchgear Now Greatly Increased in Allis-Chalmers Switchgear Plant.

Outdoor Switchgear Redesigned for Greater Accessibility, Better Service . . . Welded-In Floor Plates, Full Length Instrument Panels, Better Ventilation, Increased Compartmention.

New Low Voltage Switchgear Simplified. Improved Breakers, Easier Access for Maintenance.

Check This Modern Line of Allis-Chalmers Switchgear For YOUR System Protection Today!

YOU CAN SELECT standardized switchgear for your system quicker with the help of Allis-Chalmers engineers. *Standard* Allis-Chalmers Switchgear is *prefabricated*, wired and assembled. Easy to install, it permits future expansion with a minimum of engineering.

Sturdy, welded steel framework is sheet steel enclosed. Safety-engineered compartments insure complete operating protection.

Circuit breakers are designed for fast circuit interruption, long-life operation. Greater accessibility, elimination of excess component parts means fewer linkages, fewer operating parts. Maintenance is simplified.

These features are a product of 50 years of experienced engineering — a first requirement in reliable protective equipment.

Result: A-C in cooperation with your engineers can advise you on equipment for your fault current, voltage, temperature and other specific requirements.

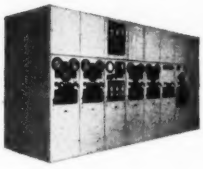
Mail coupon or call your nearby A-C Sales Office for further details.

Ruptair and *Ruptor* are Allis-Chalmers trademarks.

Modern Design SWITCHGEAR:

VERTICAL LIFT

5 kv and 15 kv — interrupting capacities through 500 mva. Metal-clad, complete with instruments, instrument transformers, buses, circuit breakers, and control wiring. Used on Ruptair, Oil or Air Blast circuit breakers.



HORIZONTAL DRAWOUT

600 volts ac and 250 volts dc. Interrupting ratings to 100,000 amperes. Dead front, metal-enclosed. Pantograph frame for easy breaker withdrawal. Protective barriers and devices. Single main bus for incoming connections, greater accessibility, and ready inspection.

CUBICLE

15 kv — interrupting capacities over 500 mva. Complete phase segregation with maximum protection for electrical equipment and operating personnel. Stationary air blast circuit breakers.

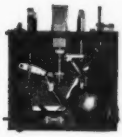
Pioneers in Power and Electrical Equipment From Generation Through Utilization

ALLIS-

on Allis-Chalmers Switchgear

Improved CIRCUIT BREAKERS:

AIR BLAST



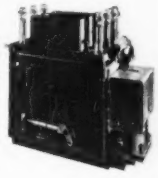
Clears circuits in minimum time. Interrupts arc in less than one cycle. Uses prestored air for operation. Primarily used with metal-clad, vertical lift switchgear. Rated at 15 kv, 500 mva and above.

LOW VOLTAGE AIR

Modernized G-25 and G-50 air circuit breakers for 600 volt service and below. Built for repetitive operation. Insensitive to shock and vibration; adaptable for light currents of low power factor.

The G-25 and G-50 meet all standardized requirements of NEMA, AIEE and other electrical requirements. Equipped with inverse time series overcurrent trip. Stationary or drawout construction. Manual or electrical operation.

MAGNETIC AIR



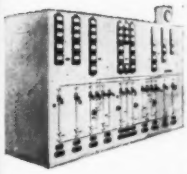
The "Ruptair" circuit breaker is designed for service of 5 kv, 250 kva and below. Individual phase barriers. Self-aligning finger type main disconnects have 360° contact. Completely oilless and self-contained. Employs horizontal contact separation for reliable arc extinction.

OIL

Oil tight enclosed mechanism of low inertia, straight line motion type. Wide application for central station and industrial service. Ideal for economy of space and operation. Equipped with Ruptors to reduce contact burning and oil deterioration. Silver plated main contacts, arc resistant arcing contacts. Oil and gas separator.

Many Types of SWITCHBOARDS:

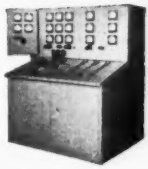
DUPLEX



For centralized control — controls and instruments within easy reach of operator. Segregated relay and operating equipment. Front: control switches, indicating instruments, annunciators. Back: relays, recorders, test facilities. Wiring carried in special troughs, terminal blocks for quick connections, easy inspection.

BENCHBOARD

All equipment in front. Meters, instruments, relays mounted on vertical panel. Control switches, rheostats, etc. mounted on bench section. Doors or removable plates give access to rear wiring and connections. Dead front.



OPEN

Standard switchboard panels for specific applications . . . for control of generators, motors, transformers, rectifiers, feeder lines for all municipal and industrial applications where space is limited and enclosed types not warranted. Includes necessary accessories on front panel. Ready access to rear wiring and terminal blocks.

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Please send me information on:

.....

Name.....

Title.....

Company.....

Address.....

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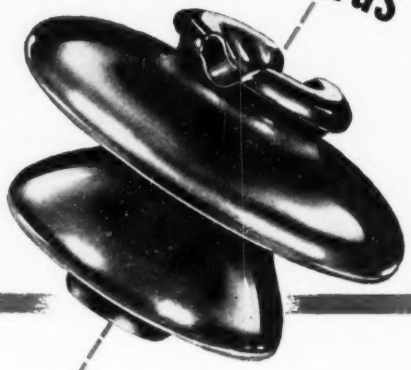
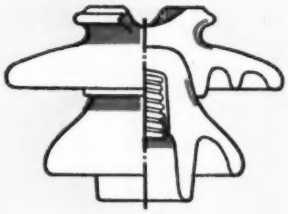
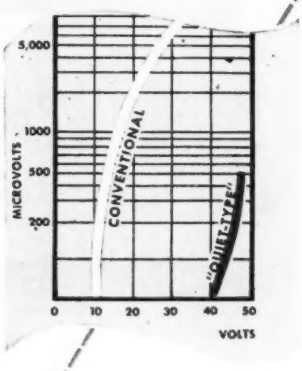
A-C ALLIS CHALMERS

CHALMERS

THOMAS "QUIET-TYPE" INSULATORS set tomorrow's standards







● Typical Thomas advancement, is our complete line of *patented "Quiet-Type" Insulators. Record acceptance by the industry, proves these radio noise-free pin types are setting tomorrow's standards. It's not surprising . . . for they eliminate all insulator radio-interference.

Thomas engineers pioneered and were first to develop the under-glaze metallic oxide coating—applied to the areas indicated by red in the center sketch. The result is a barely discernible coating—contamination free because it's *under the glaze.* Sprayed on before firing (top sketch) it becomes a permanent part of the porcelain—can't come off and guarantees positive noise-free operation without sacrificing any insulating qualities.

Line and laboratory tests prove the superiority of these insulators over conventional types. As you see on the bottom graph, it takes four times as much voltage to produce noise-making microvolts with the Thomas "Quiet-Type" design.

In terms of customer goodwill your Thomas "Q-T" Insulators earn their slight additional cost many times over.

Write for free illustrated brochure describing these modern "Q-T" Insulators.

*Patent No. 2154387

1873 THOMAS INSULATORS our 76th year RELIABILITY 1949

The R. Thomas and Sons Co.

LISBON, OHIO
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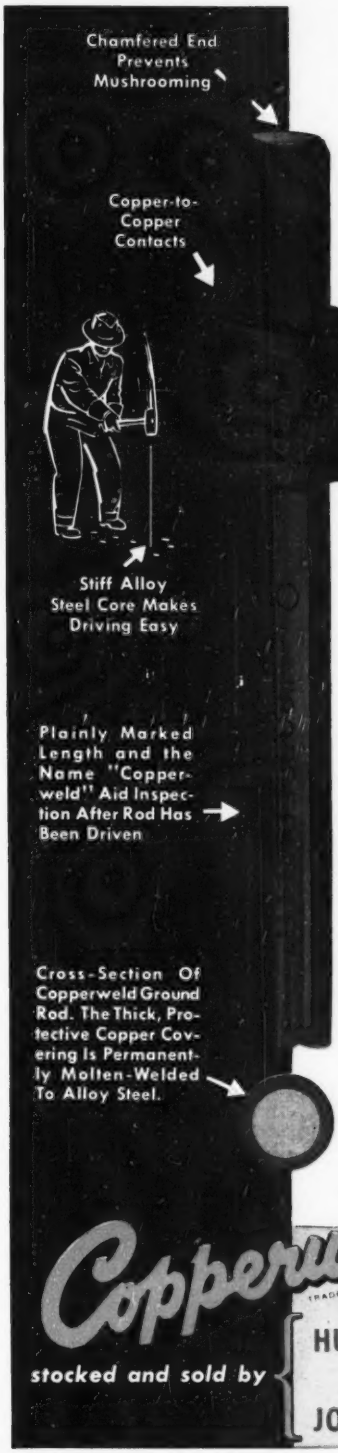
AGENTS IN PRINCIPAL CITIES


Chamfered End Prevents Mushrooming
Copper-to-Copper Contacts
Stiff Alloy Steel Core Makes Driving Easy
Plainly Marked Length and the Name "Copperweld" Aid Inspection After Rod Has Been Driven
Cross-Section Of Copperweld Ground Rod. The Thick, Protective Copper Covering Is Permanently Molten-Welded To Alloy Steel.

Copperweld

TRADE MARK

. . . The *Only* Ground Rod with a Thick Copper Covering

INSEPARABLY MOLTEN-WELDED to a Strong Alloy Steel Core

It is "Molten-Welding" that makes the Copperweld* Ground Rod different—and better.

For, by this unique process—used only by Copperweld Steel Company—the strong, tough alloy steel core and the thick armor of copper that protects it are inseparably welded together. Only Molten-Welding permanently interlocks the copper and steel—achieves a union so perfect that the two metals cannot be separated.

The rugged alloy steel core of Copperweld Ground Rods gives the stiffness you need for easy driving. Lasting protection against corrosion is provided by the heavy molten-welded copper covering.

Millions of Copperweld Ground Rods now in use are rendering permanent grounding protection. You're SAFE when you use Copperweld. They give you PROVED dependability—PROVED economy—PROVED longer service.

Look For This Name . . . It Protects You!

MADE BY

COPPERWELD STEEL COMPANY

GLASSPORT, PA.

*Trade Mark

Copperweld TRADE MARK **GROUND RODS AND CLAMPS**

stocked and sold by

HUBBARD & COMPANY, National Sales Agents
and all their distributors
and
JOSLYN MFG. & SUPPLY CO., National Distributors

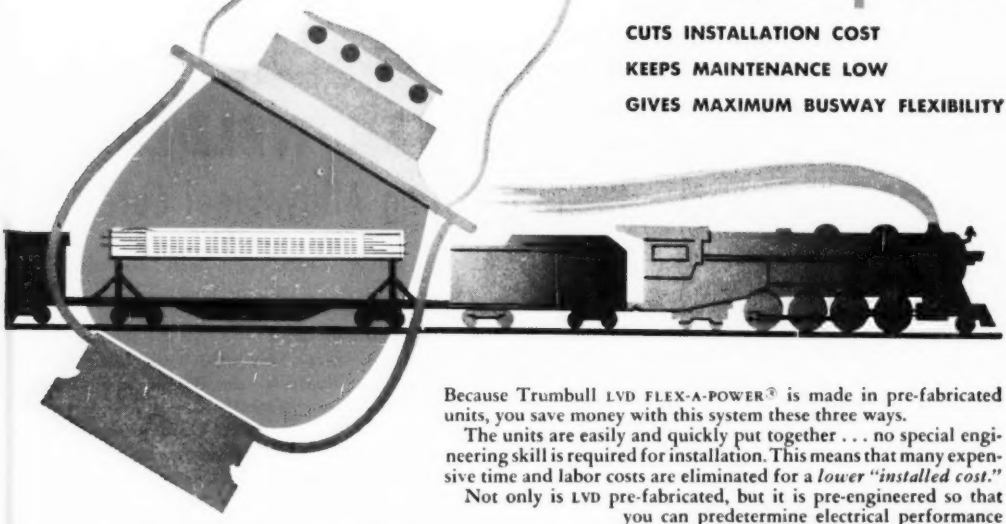
STOP, LOOK AND READ HOW EASILY

LVD Flex-a-power

CUTS INSTALLATION COST

KEEPS MAINTENANCE LOW

GIVES MAXIMUM BUSWAY FLEXIBILITY



Because Trumbull LVD FLEX-A-POWER® is made in pre-fabricated units, you save money with this system these three ways.

The units are easily and quickly put together . . . no special engineering skill is required for installation. This means that many expensive time and labor costs are eliminated for a *lower "installed cost."*

Not only is LVD pre-fabricated, but it is pre-engineered so that you can predetermine electrical performance before actual installation. This advantage is an important factor in minimizing voltage drop and in keeping machine efficiency high.

LONG-LIVED MATERIALS —

Another advantage — LVD FLEX-A-POWER materials do not deteriorate even under the most severe operating conditions, thus assuring years of satisfactory service *without costly maintenance repairs.*

ADAPTABLE, "TAKE-APARTABLE" —

LVD FLEX-A-POWER is readily adaptable to any power distribution problem you may have. Fast to install, its convenient "take-apart-ability" allows you to relocate your LVD system without replacing a single part!

Learn more about the many advantages of LVD. Write for Circular TEC 152 today. THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn.

Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

TIREX
SELENIUM
Neoprene Armor
Unequalled for Long Life
Resistance to
Abrasion
Flames
Oil

SYMBOL OF EXTRA-LONG CABLE LIFE

The Simplex-TIREX Selenium Neoprene emblem is a symbol of longer portable cord and cable life and more-dependable service for it stands for the exclusive Tirex jacket that is unsurpassed for resistance to the hazards of nature, and is **cured-in-lead** to provide unfailing protection against mechanical "wear and tear".

Crushing and twisting, sunlight and foul weather, oil, heat and flame all find Selenium Neoprene Armor more than their equal. And you will find it to be security against untimely breakdowns and low output whenever your portable electric apparatus is Tirex-equipped.

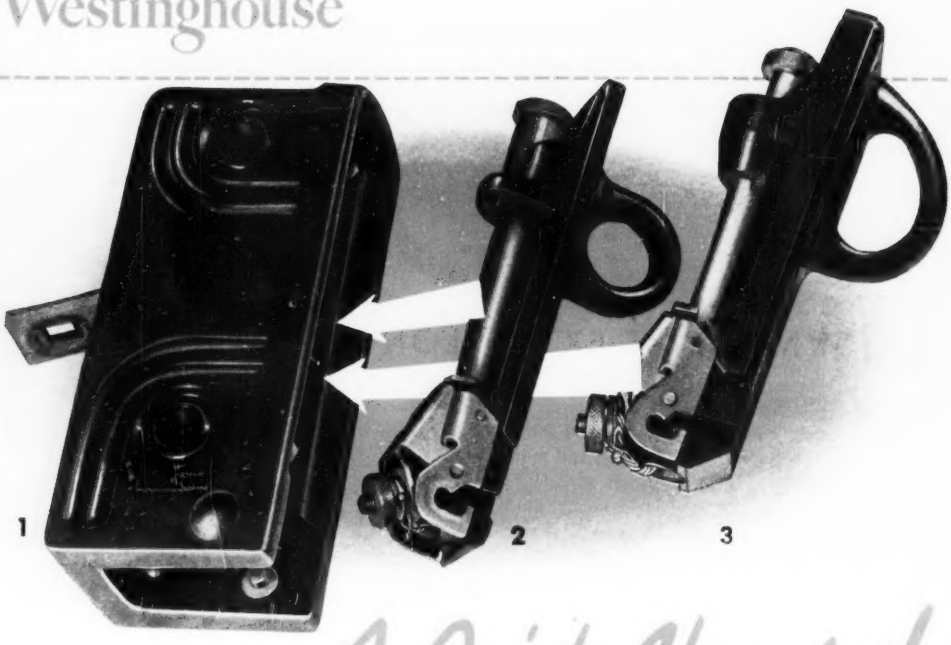
Selenium Neoprene Armor, **cured-in-lead**, is a feature of every TIREX Cord and Cable. TIREX is made in sizes and types to meet every requirement for use on all portable equipment. Ask the Simplex representative in your area to help you select those best suited to your needs.

Simplex-Tirex

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



A Quick Changer!

...for fast re-fusing..for future expansion

Interchangeability keynotes Westinghouse porcelain-enclosed cutouts. Only Westinghouse gives you this versatility in line protection. Consider what this means:

First, fuse replacements are fast . . . safe . . . easy. Lineman removes door with hookstick—replaces it with a fused door. Fuse links can be replaced at the truck or in the shop.

Second, as line capacity outgrows the cutout interrupting rating, the EA cutout door may be replaced with the new Type HC (high interrupting capacity) door—either dropout or non-dropout type. That's because *any* door will fit *any* housing.

In addition, you get greater safety; complete hookstick operation; 180° dropout for clear indication of blown fuse; cool operation; light weight combined with great mechanical and electrical strength.

These cutouts are available now in a range of sizes to meet your requirements. See the versatility of this cutout. Ask your nearby Westinghouse representative or distributor for a personal demonstration and Booklets B-3833 and B-4299. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-60705

1. PRESTITE PORCELAIN HOUSING—50-ampere, 5-kv, identical for both Type EA and Type HC cutouts.

2. MOLDARTA TYPE EA DOOR—1,200-ampere interrupting capacity.

3. MOLDARTA TYPE HC DOOR—Interchangeable with Type EA cutout door. Interrupting capacity 8,000 amperes at 2,500 volts, 5,000 amperes at 5,000 volts.

Westinghouse

FUSE CUTOUTS

FOR ANY SYSTEM

PENTA CHLOROPHENOL preservative

(Santophen 20)

Lineman prefers Penta-treated pole

CLEAN, THOROUGH PROTECTION all along the line

The Monsanto Penta treatment is the dependable way to give wood long-lasting protection against rot, termites and other wood-boring insects. Penta solutions penetrate thoroughly — leave poles CLEAN and dry . . . This means better workability for linemen, improved appearance.

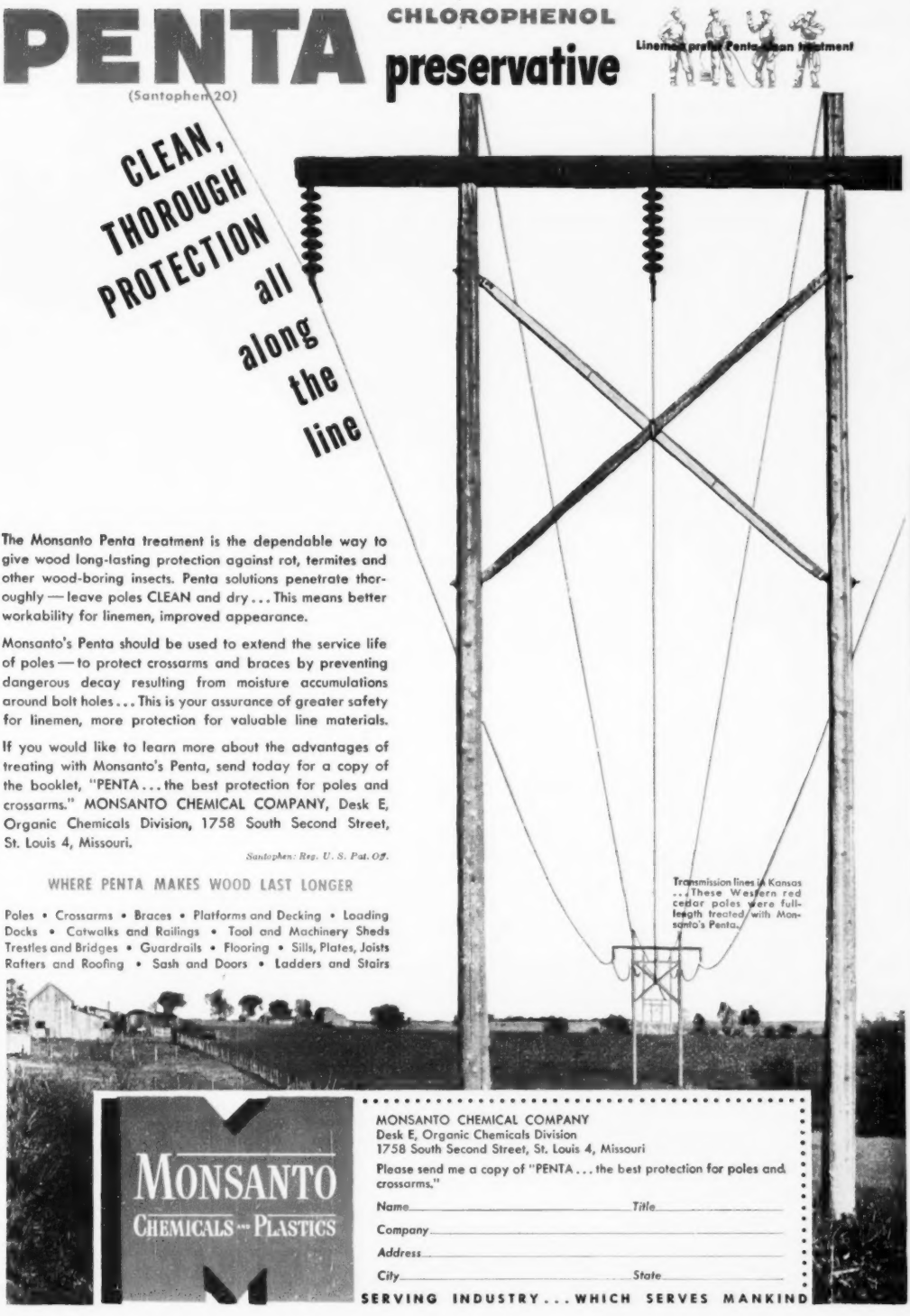
Monsanto's Penta should be used to extend the service life of poles — to protect crossarms and braces by preventing dangerous decay resulting from moisture accumulations around bolt holes . . . This is your assurance of greater safety for linemen, more protection for valuable line materials.

If you would like to learn more about the advantages of treating with Monsanto's Penta, send today for a copy of the booklet, "PENTA . . . the best protection for poles and crossarms." MONSANTO CHEMICAL COMPANY, Desk E, Organic Chemicals Division, 1758 South Second Street, St. Louis 4, Missouri.

Santophen: Reg. U. S. Pat. Off.

WHERE PENTA MAKES WOOD LAST LONGER

Poles • Crossarms • Braces • Platforms and Decking • Loading Docks • Catwalks and Railings • Tool and Machinery Sheds Trestles and Bridges • Guardrails • Flooring • Sills, Plates, Joists Rafters and Roofing • Sash and Doors • Ladders and Stairs



Transmission lines in Kansas . . . These Western red cedar poles were full-length treated with Monsanto's Penta.

MONSANTO
CHEMICALS PLASTICS

MONSANTO CHEMICAL COMPANY
Desk E, Organic Chemicals Division
1758 South Second Street, St. Louis 4, Missouri

Please send me a copy of "PENTA . . . the best protection for poles and crossarms."

Name _____ Title _____

Company _____

Address _____

City _____ State _____

SERVING INDUSTRY . . . WHICH SERVES MANKIND

Tops IN THE MILE-HIGH LEAGUE!

● The Public Service Company of Colorado handles electricity and gas distribution and transmission for its customers in the mountainous north-central portion of the state. For maintenance work, for readings, for "cutting in" new equipment in inaccessible areas where other means of communication are not available, the company finds G-E radio an indispensable, money-saving tool.

This utility's trouble trucks, line trucks, patrol vehicles and compressors, as well as supervisors' cars are in touch with one another and with headquarters at Denver by radio.

J. M. Wissenbach, Engineering Department, shown above, reports that dispatching by G-E radio *materially cuts elapsed time between receipt of complaint and adjustment of trouble.*

General Electric specializes in radio communication systems for utilities faced with difficult problems of terrain or weather. For complete information call the G-E office nearest you or write: *General Electric Company, Box 1122, Electronics Park, Syracuse, New York.*

Before You Select Any Radio Communication Equipment—

Get This Bulletin FREE!

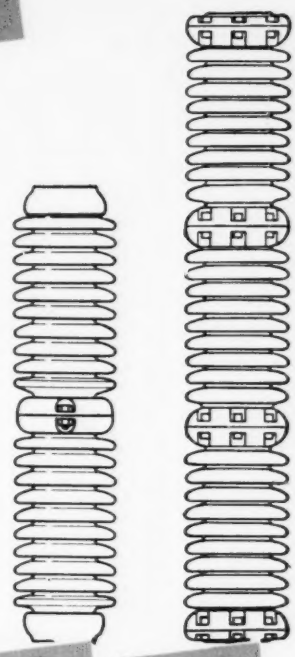
Colorful booklet about General Electric radio communication will be sent to you on request. Ask for it.

You, too, can put your confidence in—

GENERAL ELECTRIC

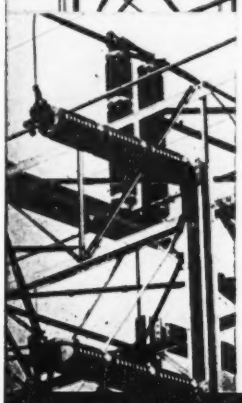
FOR SWITCH
AND BUS SUPPORT
AT 115-161 KV
LAPP STATION POSTS

For more than 17 years the Lapp Post design has been proving its advantages in operation . . . in rigidity . . . in permanence . . . in superior performance under arcover . . . in elimination of puncture or cracking . . . in better operating characteristics under atmospheric contamination. The same advantages that have been so spectacular on the operating records of many power companies are even more significant at higher voltages. For new construction or maintenance of important high-voltage stations, investigate the advantages of the Lapp Post units shown at the right.

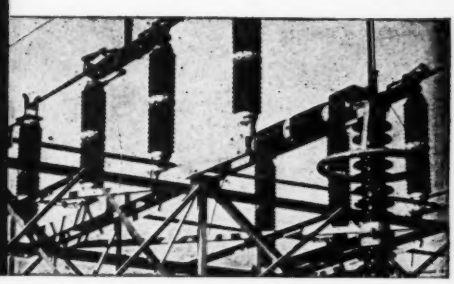


LAPP STATION POST 115 KV

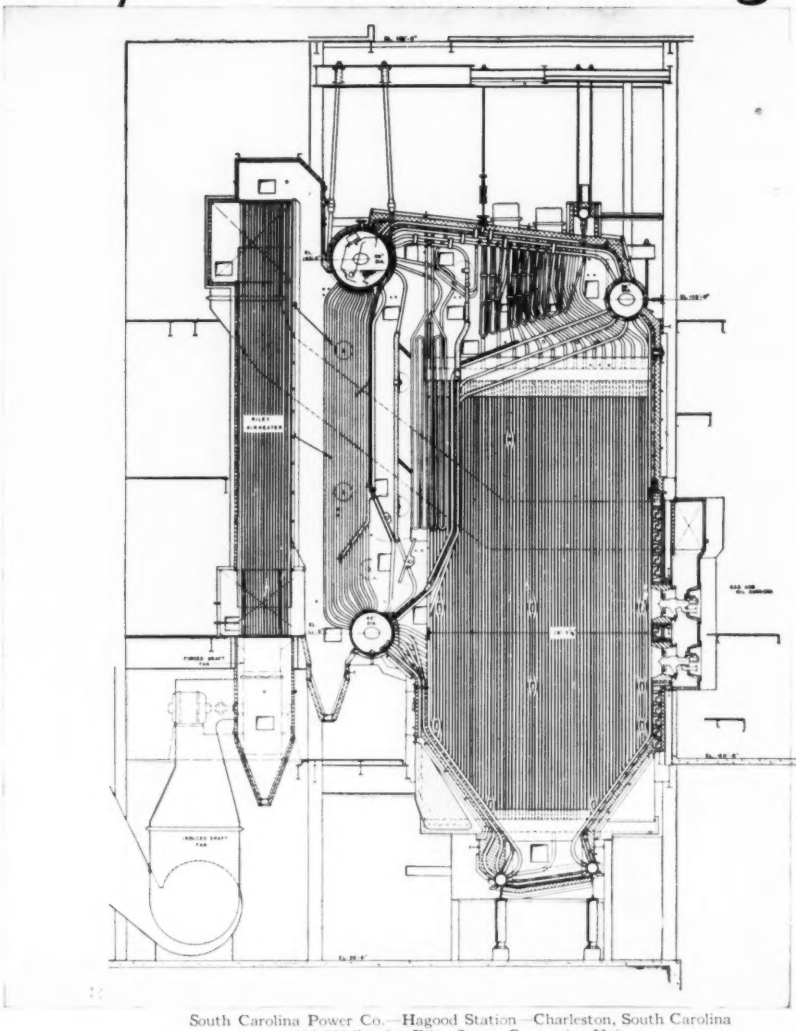
LAPP STATION POST 138-161 KV



Lapp
STATION POSTS
LAPP INSULATOR CO., INC. • LE ROY, N.Y., U. S. A.



Riley Steam Generating Units



South Carolina Power Co.—Hagood Station—Charleston, South Carolina
230,000 lbs. hr. Riley Steam Generating Unit
975 lbs. Pressure. 860° F. Steam Temperature. Initially Oil Fired
Two additional units, 1—230,000 lbs. hr. and 1—310,000 lbs. hr.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans Memphis St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

selected for Hagood station

South Carolina Power installed their first Riley Unit in 1946. Two additional Riley Units will be installed in 1949, together with Riley Pulverizers for all three units

South Carolina Power Company selected a 230,000 lbs./hr. oil-fired Riley Steam Generating unit as unit No. 1 for their Hagood Station at Charleston, South Carolina. When increased demand necessitated enlarging the station, a substantially duplicate Riley unit was selected as well as a 310,000 lbs./hr. Riley unit.

Similar Riley Units also at Gulf Power and Mississippi Power Plants

Gulf Power Company and Mississippi Power Company have also installed five Riley units similar to the unit illustrated. Throughout the country the use of Riley pulverized coal-fired steam generating units has expanded rapidly. Look over the accompanying list of recent Riley units in public utility plants. Houston Lighting & Power Company alone has installed or has on order nine Riley Steam Generating units having a steam capacity of 4,590,000 lbs. of steam per hour.

Riley users will tell you—you can rely on Riley

The regularity with which Riley Steam Generating unit users repeat for additional Riley units when plants are expanded is positive proof of the excellent performance of Riley units, their reliability and the satisfactory service rendered by the Riley organization. Riley users will gladly confirm that "you can always rely on Riley."

A Few of the many Riley Public Utility Installations

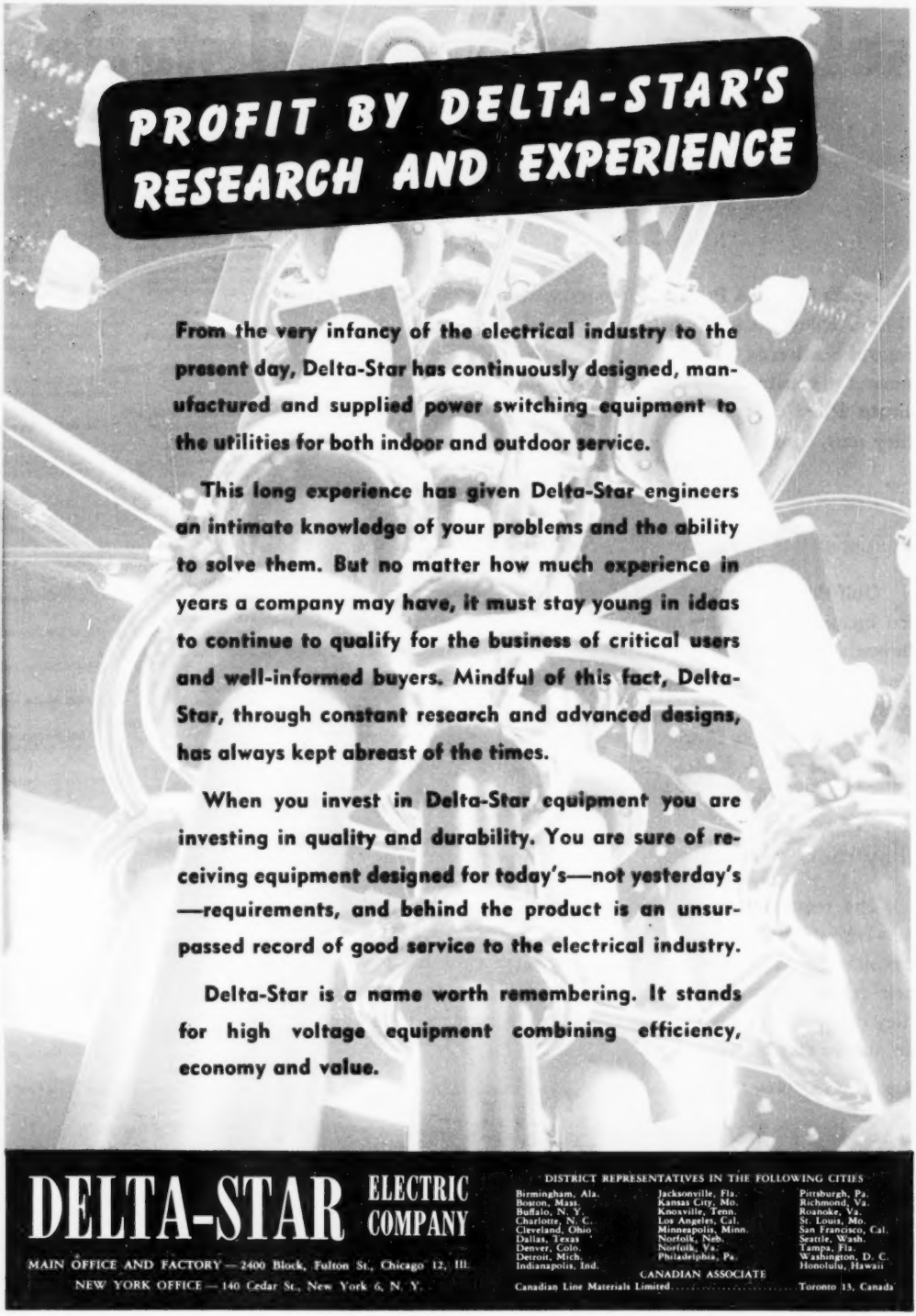
Houston Lighting & Power Co.		
West Junction Station	2–850,000 lbs.	hr. units
West Junction Station	2–400,000 lbs.	hr. units
Greens Bayou Station	2–675,000 lbs.	hr. units
Gable Street Station	1–350,000 lbs.	hr. unit
Gable Street Station	1–250,000 lbs.	hr. unit
Gable Street Station	1–140,000 lbs.	hr. unit
Public Service Co. of Indiana		
Dresser Station	1–300,000 lbs.	hr. unit
Edwardsport Station	3–400,000 lbs.	hr. units
Noblesville Station	3–300,000 lbs.	hr. units
Utah Power & Light Company		
Orem Station	1–450,000 lbs.	hr. unit
Jordan Station	1–620,000 lbs.	hr. unit
Arkansas Power & Light Co.		
Cecil Lynch Station	1–650,000 lbs.	hr. unit
City of Los Angeles		
Harbor Steam Station	3–825,000 lbs.	hr. units
Harbor Steam Station	2–675,000 lbs.	hr. units
Central Illinois Light Co.		
R. S. Wallace Station	1–600,000 lbs.	hr. unit
R. S. Wallace Station	1–375,000 lbs.	hr. unit
R. S. Wallace Station	2–300,000 lbs.	hr. units
Southwestern Public Service Co.		
Borger, Texas	1–330,000 lbs.	hr. unit
Carolina Power & Light Co.		
Moncure Station	2–330,000 lbs.	hr. units
Worcester County Electric Co.		
Webster Street Station	1–325,000 lbs.	hr. unit
New Orleans Public Service Co.		
Market Street Station	1–330,000 lbs.	hr. unit
Pennsylvania Electric Co.		
Williamsport Station	1–300,000 lbs.	hr. unit
Iowa Illinois Gas & Electric Co.		
Riverside Station	3–250,000 lbs.	hr. units
Coralville Station	1– 60,000 lbs.	hr. unit
South Carolina Power Co.		
Hagood Station	1–310,000 lbs.	hr. unit
Hagood Station	2–230,000 lbs.	hr. units
Mississippi Power Co.		
Plant Eaton	3–230,000 lbs.	hr. units
Gulf Power Company		
Pensacola, Fla.	2–230,000 lbs.	hr. units
West Penn Power Co.		
Milesburg Station	2–210,000 lbs.	hr. units
Ohio Edison Company		
Mad River Station	1–250,000 lbs.	hr. unit
Akron Heating Station	2– 90,000 lbs.	hr. units
Interstate Power Co.		
Lansing Station	2–120,000 lbs.	hr. units
Fox Lake Station	2–120,000 lbs.	hr. units
Clinton Station	1– 45,000 lbs.	hr. unit
Central Ohio Light & Power Co.		
Woodcock Station	2–120,000 lbs.	hr. units
Woodcock Station	1– 90,000 lbs.	hr. unit
Woodcock Station	2– 60,000 lbs.	hr. units

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in [illegible] costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS



PROFIT BY DELTA-STAR'S RESEARCH AND EXPERIENCE

From the very infancy of the electrical industry to the present day, Delta-Star has continuously designed, manufactured and supplied power switching equipment to the utilities for both indoor and outdoor service.

This long experience has given Delta-Star engineers an intimate knowledge of your problems and the ability to solve them. But no matter how much experience in years a company may have, it must stay young in ideas to continue to qualify for the business of critical users and well-informed buyers. Mindful of this fact, Delta-Star, through constant research and advanced designs, has always kept abreast of the times.

When you invest in Delta-Star equipment you are investing in quality and durability. You are sure of receiving equipment designed for today's—not yesterday's—requirements, and behind the product is an unsurpassed record of good service to the electrical industry.

Delta-Star is a name worth remembering. It stands for high voltage equipment combining efficiency, economy and value.

DELTA-STAR ELECTRIC COMPANY

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NEW YORK OFFICE — 140 Cedar St., New York 6, N. Y.

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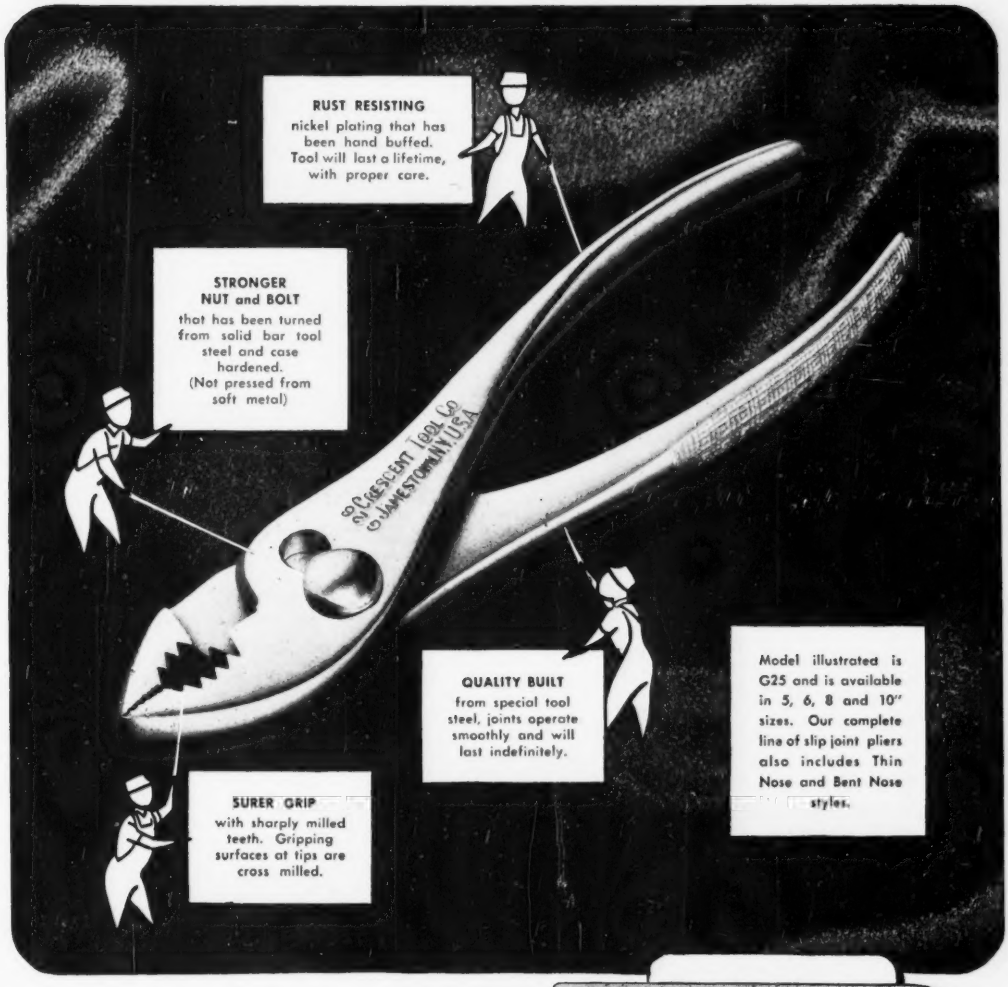
CANADIAN ASSOCIATE

Canadian Line Materials Limited ..... Toronto 13, Canada

CRAFTSMEN RECOGNIZE QUALITY *by these fine features in*

SLIP-JOINT PLIERS


RUST RESISTING
nickel plating that has been hand buffed. Tool will last a lifetime, with proper care.
STRONGER NUT and BOLT
that has been turned from solid bar tool steel and case hardened. (Not pressed from soft metal)
CRESCENT TOOL CO
JAMESTOWN N.Y. U.S.A.
QUALITY BUILT
from special tool steel, joints operate smoothly and will last indefinitely.
Model illustrated is G25 and is available in 5, 6, 8 and 10" sizes. Our complete line of slip joint pliers also includes Thin Nose and Bent Nose styles.
SURER GRIP
with sharply milled teeth. Gripping surfaces at tips are cross milled.

EVERYBODY RECOGNIZES QUALITY *by this Trade-mark*

CRESCENT TOOLS

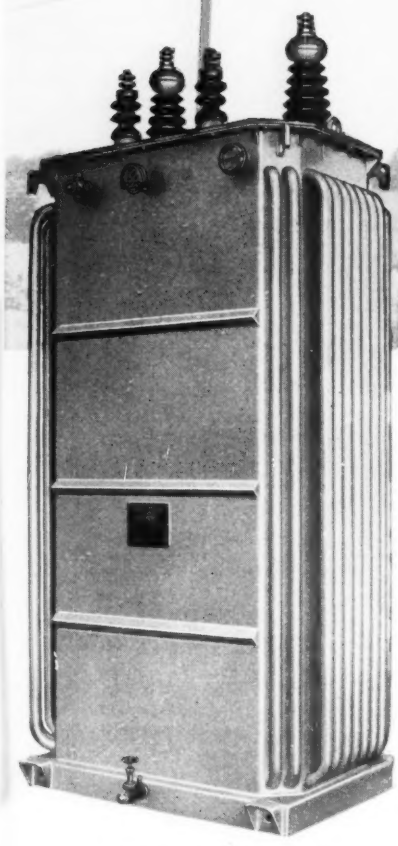
Sign of the Artisan
Symbol of Excellence

"Crescent" is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Wagner Substation Transformers

for rural application



Wagner 500 kva, 46,000 to 7200 volt, type HEL Transformer. These units are available in sizes 167 to 500 kva in standard voltage combinations up to 69 kv. Bulletins TU-180 and TU-181 give full information on Wagner Substation Transformers.

Available in all standard kva and voltage ratings

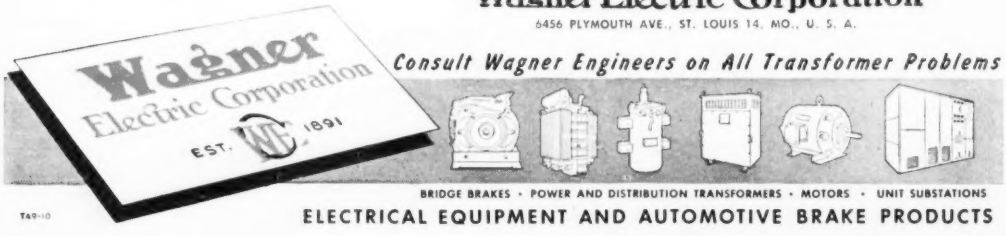
Wagner Substation Transformers are serving on hundreds of rural-line systems in operation throughout the country. They have shown the stamina to perform dependably under ever-increasing loads and have established an enviable service reputation in the field.

If you are planning increased system capacity, investigate the advantages of Wagner Substation Transformers.

Wagner transformers are known for their high standards of quality and performance based on almost six decades of designing and building distribution and power transformers. Trained field engineers in our 29 branch offices, located in principal cities, are ready to help solve your Rural-Line Transformer problems.

Wagner Electric Corporation

6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.



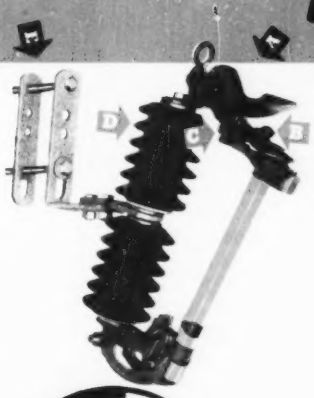
Consult Wagner Engineers on All Transformer Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

TA9-10

DEPENDABLE PROTECTION WITH



Type 33 Dropout CUTOUTS

A Sleet-shield top latch provides dependable operation under all weather conditions.

B Positive dropout action is assured by knee-action mechanism at top and bottom of tube assembly.

C Dependable operation at full rated current is assured by evenly distributed pressure and full wiping action of solid copper contacts.

D Insulator replacement costs are lower with Southern States two-piece insulator units.

E Universal mounting bracket provides either cross-arm or pole mounting.

F Self-locking hinge prevents tube falling out on down swing.

G Positive semaphore! Completely open position provides unmistakable indication of blown fuse. Tube quickly and easily removed and replacement installed with hook stick.

WRITE FOR BULLETINS ON THE ENTIRE LINE

Southern States Equipment Corp.

HAMPTON GEORGIA

Representatives in:

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A Half-Century of Varnish Research

NOW BRINGS YOU

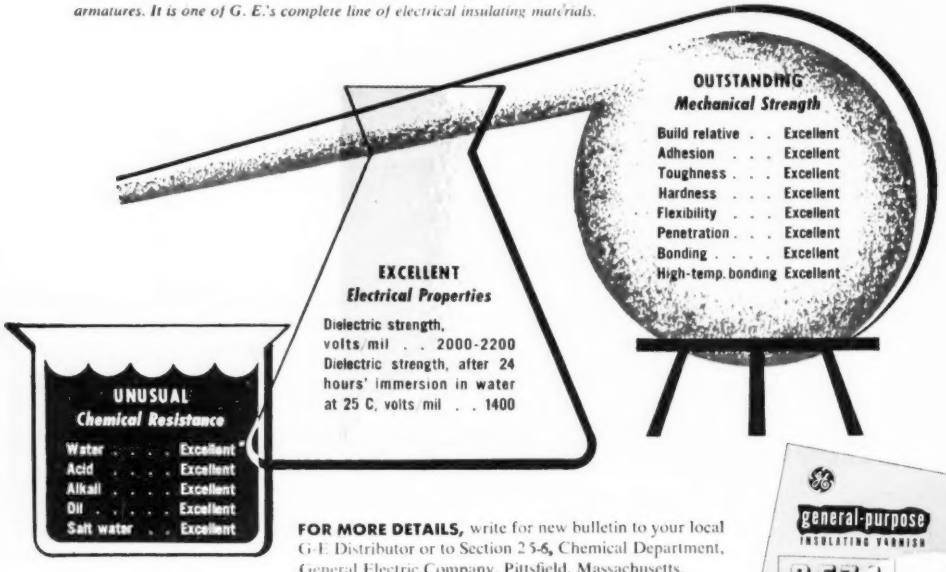
G-E'S NEW GENERAL-PURPOSE* INSULATING VARNISH— G-E 9574

Motor repair men and electrical equipment manufacturers will find it pays to investigate this new varnish. G-E 9574 represents the attainment of a long-sought goal—a varnish for *all* insulating purposes which combines in a single material the electrical, chemical, and mechanical qualities previously found at their best only in individual special-purpose varnishes.

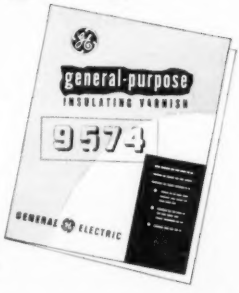
In addition, general-purpose varnish 9574 is *easy* to use. It is remarkably stable and does not tend to harden in the tank. It penetrates the deepest coils quickly and easily; bakes at low temperatures and can be used at barrel gravity or reduced with ordinary petroleum spirits for many applications.

Double-check these statements by the property tables below.

**G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G. E.'s complete line of electrical insulating materials.*


OUTSTANDING
Mechanical Strength
Build relative . . Excellent
Adhesion . . . Excellent
Toughness . . . Excellent
Hardness . . . Excellent
Flexibility . . . Excellent
Penetration . . . Excellent
Bonding . . . . Excellent
High-temp. bonding Excellent
EXCELLENT
Electrical Properties
Dielectric strength, volts/mil . . 2000-2200
Dielectric strength, after 24 hours' immersion in water at 25 C, volts/mil . . 1400
UNUSUAL
Chemical Resistance
Water . . . Excellent
Acid . . . . Excellent
Alkali . . . . Excellent
Oil . . . . . Excellent
Salt water . . Excellent

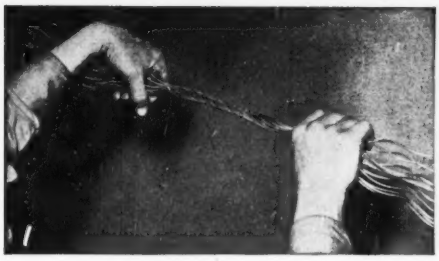
FOR MORE DETAILS, write for new bulletin to your local G-E Distributor or to Section 25-6, Chemical Department, General Electric Company, Pittsfield, Massachusetts.



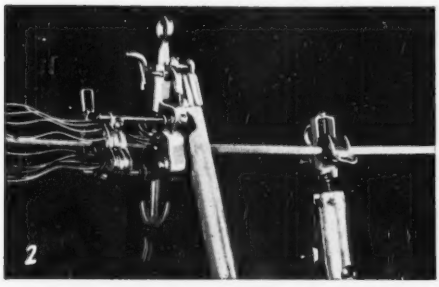
You can put your confidence in—

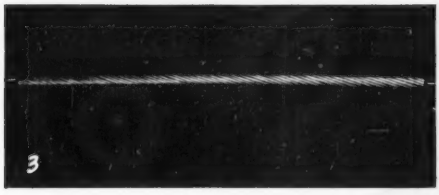
GENERAL ELECTRIC

CD10-M5



PLP hot-line TAP ARMOR . . . easy to apply-



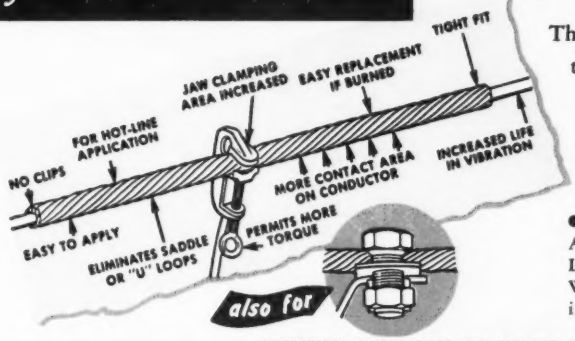


● Tap-Armor Rods are simply short lengths of PLP Armor Rods. They assure the same simplicity and ease of application. For hot-line taps, they eliminate troublesome concentrations of stresses; prevent arcing and resultant burning of the conductor caused by loosened clamps; and give a positive damping of vibration...one of the main causes of loosened clamps.

FOR COLD-LINE application, simply twist and wipe into place on the conductor as shown by Figure 1. No special tools are needed. PLP Tap Armor grips so snugly that clips or clamps are eliminated.

FOR HOT-LINE application, the set of tools shown in Figure 2 makes the job easy. Safely and rapidly, PLP Tap Armor is put in place.

The result for either hot or cold lines is the same . . . Figure 3. Conductor life is increased, electrical and mechanical characteristics are improved. A COOL clamp is the result.



● Like to know more about PLP Armor Rods? Any Salesman of Line Material Company, Locke Incorporated or American Steel & Wire Company will gladly give you complete information and prices. Or write directly to us.

PREFORMED ARMOR RODS ARE FOR USE UNDER PATENT NO. 2,275,019—OTHER PATENTS PENDING

PLP COMPANY

PREFORMED LINE PRODUCTS COMPANY
1051 POWER AVENUE • CLEVELAND 14, OHIO

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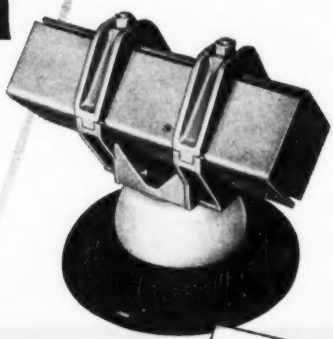
The comprehensive Burndy line includes connectors for every substation requirement . . . T connectors, couplers, expansion joints, ground connectors . . . bus support clamps for all types and sizes of tubing, flat bar and cable. All meet rigid utility requirements, both electrical and mechanical. Ask for descriptive literature, or engineering assistance. BURNDY Engineering Company, New York 54, N. Y. WESTERN BRANCH: Vernon 11, California. CANADA: Canadian Line Materials, Ltd., Toronto 13.

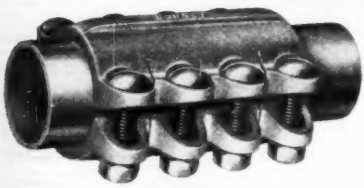


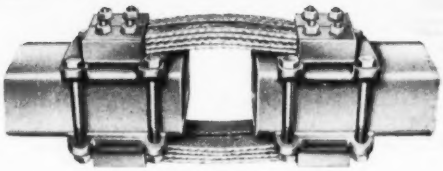
ANGLE BUS SUPPORT CLAMP
Type BH-L

25 YEARS OF SERVICE

Connect with BURNDY

COUPLER
Type NS

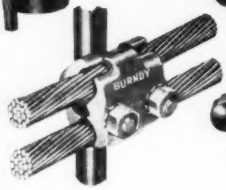




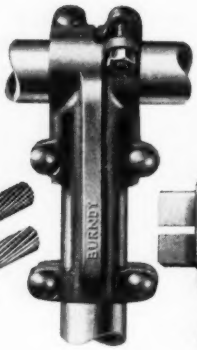
SQUARE BUS EXPANSION COUPLER
Type XPL-T

GROUND CONNECTOR
Type GAR

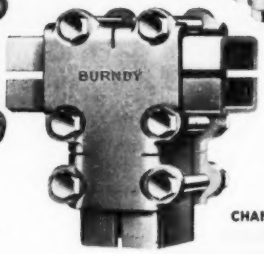
GROUND CONNECTOR
Type GB



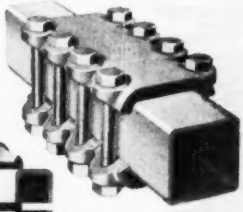
GROUND CONNECTOR
Type GP



T-CONNECTOR
Type CT



CHANNEL T-CONNECTOR
Type NT-8-90



SQUARE BUS COUPLER
Type NS-T

CHECK the FACTS

UNIVERSAL TERMINAL CLAMPS

1. They combine many odd sizes of clamps for wire, cable and tubing—eliminate specifying diameters except for special conductor requirements.
2. Mounts on terminal pad with four half inch bolts on 1¾" centers.
3. Choice of clamp position doubles conductor range for each clamp. Note a 90 degree change in position can be made for quick selection of either of two indicated range sizes.
4. Overlapping sides of clamping cradle hold cable strands together.
5. Only three clamps cover full Conductor range—Wire No. 4 to 4/0, Cable No. 4 to 800 MCM, Tubing 3/8 inch to 3/4 inch.
6. Two clamps for specified conductor sizes—Cable 350 MCM to 1250 MCM, Tubing—1/2 inch 3/4 incl. and one inch.

R&IE I-T-E

RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO

The Check List

DISCONNECTING SWITCHES
INDOOR AND OUTDOOR

CONDUCTOR SUPPORTS CLAMPS AND FITTINGS

HORN GAP SWITCHES

INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

DISTRIBUTION EQUIPMENT

SWITCH OPERATING MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

AUTOMATIC SWITCHING EQUIPMENT

METAL CUBICLES

TESTING DEVICES

It's Cable on the Reel that Counts!

Reynolds Metals is Shipping ACSR Cable NOW— Invites Your Inquiries for Early Delivery

Yes, it takes cable on the reel to solve those power line problems. And Reynolds has taken action to insure you of obtaining your share, for substantially less than the cost of copper.

Six million pounds of aluminum have been added to Reynolds monthly production—and all or whatever portion of it is needed will be used for ACSR and aluminum cable until your demands are supplied. First shipments of finished ACSR were made 90 days from the date Reynolds announced their entry into the cable field. Today, production is under full swing.

If you want prompt action on your cable requirements, write or call Reynolds now. You'll like both the product and the service.

IF YOU SEE RUST... YOU KNOW IT'S NOT ALUMINUM

REYNOLDS METAL

REYNOLDS METALS COMPANY • Louisville 1, Kentucky

REYNOLDS Lifetime ALUMINUM

THE COMPLETE ALUMINUM SERVICE FROM BASE METAL TO FINISHED PARTS

With the POLE STAR*

you can be sure of the NEWEST and FINEST in Distribution Transformer Design, Construction and Performance

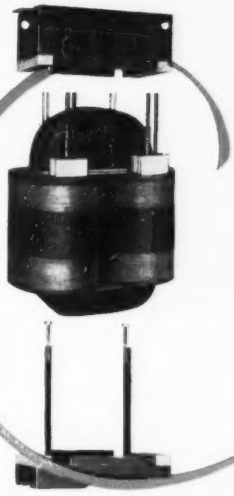
The Pole Star Transformer, conceived and developed by Pennsylvania Engineers, is one of the country's first, really NEW Post War Distribution Transformers. The physical appearance is decidedly different because pockets and pocket bushings have been eliminated and replaced with new high voltage sidewall mounted bushings and streamlined insulating caps. The advantage of removing the core to repair or replace the coils has not been overlooked in the new cold rolled steel core design. The Pole Star Transformer, now in its second year, is receiving wider and more enthusiastic acceptance. We believe this is a result of its *fine* performance record as well as its many *new* desirable features.

CUTAWAY OF HIGH VOLTAGE SIDEWALL BUSHING

Live parts of high voltage sidewall bushings are protected by rugged insulating caps hinged to the hardware. Terminals accept line leads at the same angle as pocket-type bushings. Solderless connectors are forged of naval brass to assure rugged connectors of uniform strength.

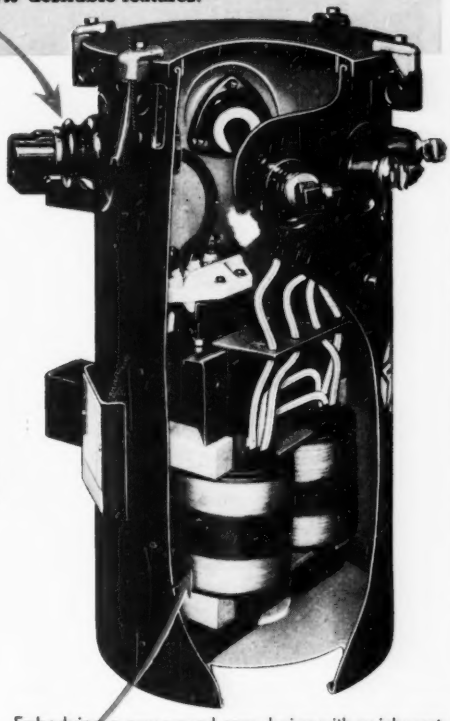
CORE AND COIL ASSEMBLY

The Pole Star core can easily be taken apart and rebuilt without special tools and without increasing the core loss or exciting current. Thus, a damaged coil can quickly and cheaply be repaired or replaced.



PRESSED STEEL CORE FRAMES

Rust and scale cannot form on the pickled and oiled steel core frames to fall off and contaminate the oil. The frames provide a very reliable support for the coils, but are independent of the core and exert no pressure on the stack of laminations.



Embodying a new wound core design with an inherent low exciting current, POLE STAR Transformers are made in sizes 25 Kva and below, 14400 volts and below, single phase, 60 cycles, OA, conforming to E.E.I.-NEMA Standards. — Will soon be available in sizes up to 100 Kva.

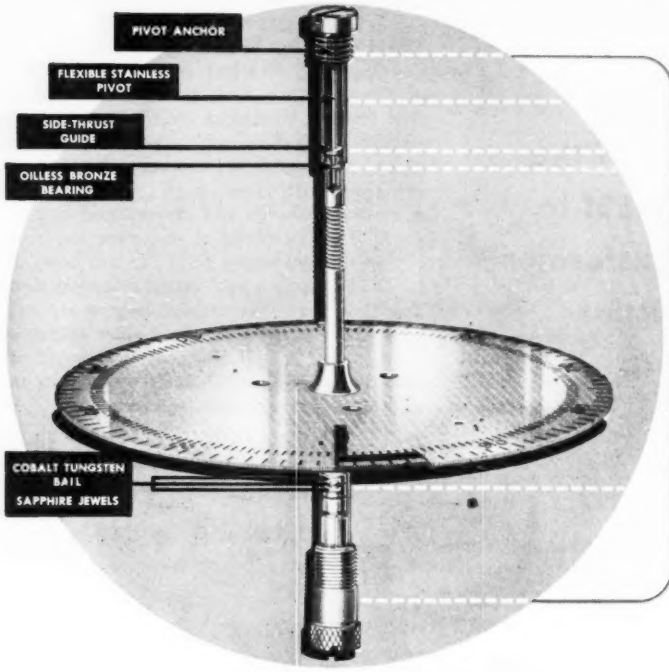
Pennsylvania TRANSFORMERS

* *P.S.* *Let the* **POLE STAR** *be your guide*

PENNSYLVANIA POLE STAR TRANSFORMER

POLE STAR Catalog No. 349 is yours for the asking.

Pennsylvania TRANSFORMER COMPANY
Pittsburgh, Pennsylvania



SERVICE PROVED BEARINGS

•

Oilless
Noiseless
Troublefree

Sangamo J Watthour Meters

Sangamo J Meters are equipped with a modern improved *oilless, noiseless, non-corrosive bearing system—proved* by 9 years of troublefree service. As shown in the diagram above, the lower bearing assembly consists of a non-ferrous cobalt tungsten ball and two sapphire jewels, while the oilless upper bearing is a flexible, stainless steel pivot of a length designed to avoid frequency vibration and the resultant noise.

Sustained Accuracy . . .

The accurate performance of this bearing system is proved by a large group of J Meters, tested after 9 years in actual customer service, which showed a variation averaging only five-hundredths of 1% in accuracy from that at the time of installation!

Troublefree Service . . .

The J Meter bearing system, non-corrosive and rustproof in all climates, has been proved troublefree by the performance records of millions of these meters in service since 1940.

Economy of Maintenance . . .

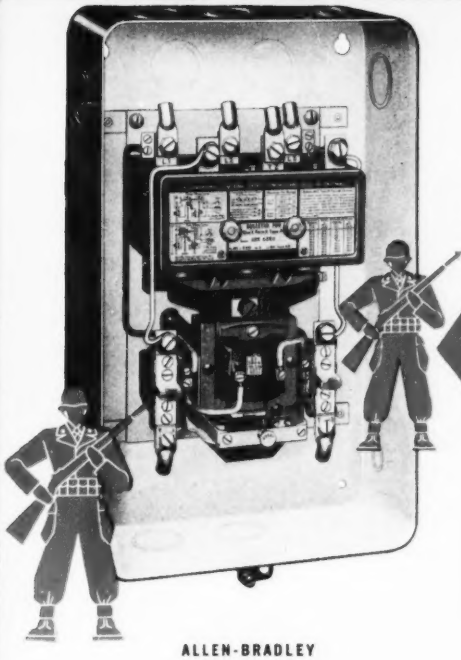
This truly modern bearing system requires no adjustment. Sangamo J Meters are built for quick and economical maintenance. All repairs are minor repairs with the Type J Meter.

* * *

Sangamo J Meters have proved their ability to meet the requirements of today and the anticipated loads of the future with sustained accuracy, economy of maintenance and troublefree performance.

50TH ANNIVERSARY SANGAMO 1899 - 1949

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS



HOW NICHROME* "SENTRIES" IN ALLEN-BRADLEY STARTERS PROTECT ELECTRIC MOTORS

Enemy ***number one*** of electric motors is overload—excessive current that causes motor windings to overheat, burn out. Here is an enemy of ***all*** motors, small or large, ready to go into action immediately a motor starts. Devices for protecting electric motors against overload, therefore, must be exceptionally dependable . . . must not fail to disconnect the motor from the line before a dangerous temperature is reached.

FOR PRECISION-PROTECTION, ALLEN-BRADLEY OVERLOAD RELAYS EMPLOY NICHROME

In controls of this type, the current that flows through the motor windings is used to heat Nichrome thermal elements in the overload relays. Thus heating of the relay element monitors the heating of the motor windings. When a dangerous motor temperature is reached, the heat from the Nichrome unit releases a contact arm in the relay, thereby disconnecting the motor from the line. Given a few seconds to cool, the relay mechanism can be reset by pressing a button—completing the motor circuit again.

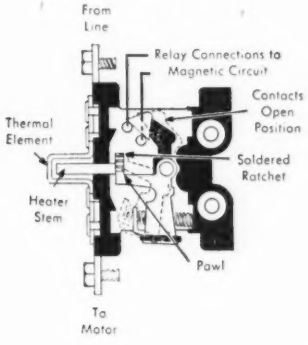
STABILITY OF NICHROME ASSURES DEPENDABLE RELAY PERFORMANCE

Because of its uniform quality, superb corrosion-resistance, and retention of physical and electrical properties at high temperatures, Nichrome is unsurpassed for the accurate job the all-important thermal unit must perform in these Allen-Bradley controls.

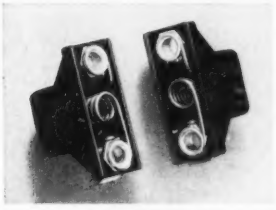
D-H ALLOYS AND YOUR REQUIREMENTS

If your products demand electrical resistance material of outstanding uniformity, high stability and long life, remember this application. Be guided by the example of Allen-Bradley and have Driver-Harris supply your needs. We fabricate the most complete line of electrical resistance alloys in the world, and will gladly make recommendations based upon your specific requirements.

ALLEN-BRADLEY RESISTO-THERM RELAY OPERATION



The heater stem is almost completely surrounded by a Nichrome thermal unit. A ratchet wheel is soldered to one end of the heater stem, and this engages a pawl which holds the relay contacts closed against spring tension. Sustained overload on the motor heats the Nichrome element which, in turn, heats the stem. Heat from the stem melts the solder, which frees the ratchet wheel. The wheel turns and releases the pawl, thereby opening the relay contacts.



TYPE N17 Thermal Unit— wound with Nichrome No. 16 B&S gauge bare wire. 3.01 amps.

TYPE N41 Thermal Unit— Nichrome No. 19 B&S gauge strip, 9/16-inch wide. 34.8 amps.

Nichrome is manufactured only by

Driver-Harris Company

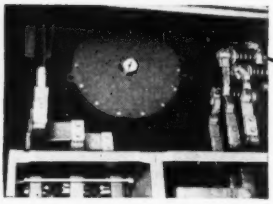
HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Seattle

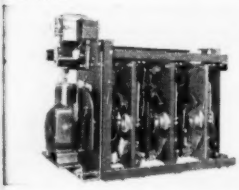
Manufactured and sold in Canada by
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

*T.M. Reg.U.S.Pat.Off.

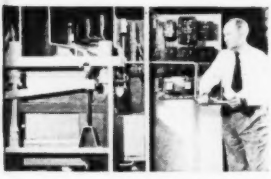
Six Points For



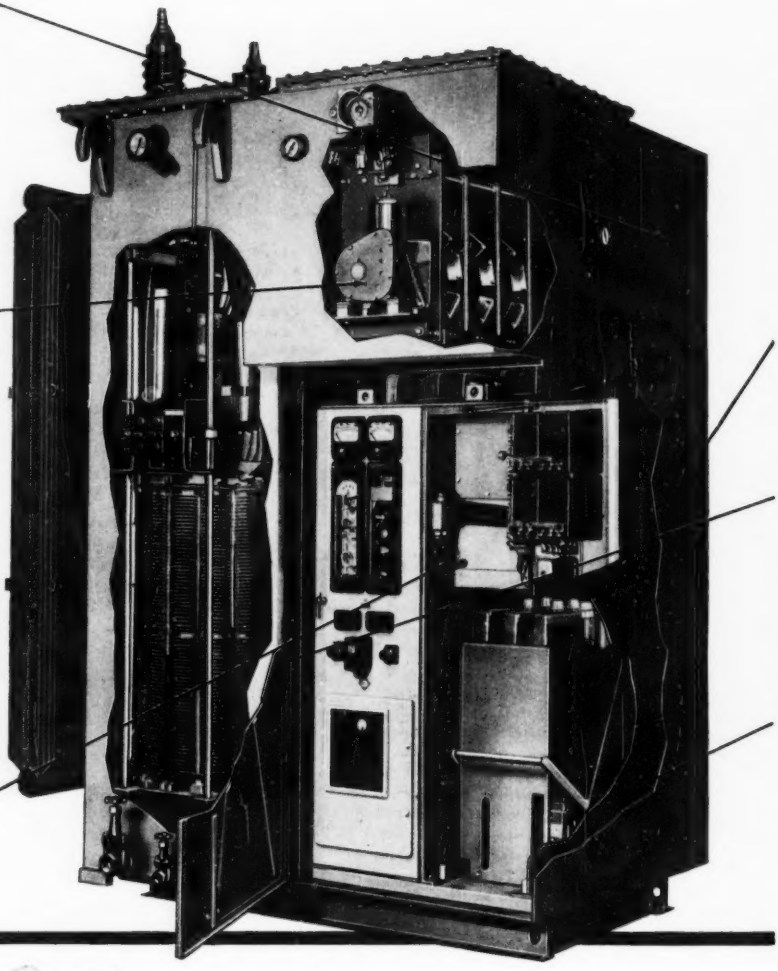
1 FLEXIBLE LEADS and taped connections reduce time for power factor and insulation tests. You have no compound-filled boxes to refill in the field. The *Oil-Sealed* inert gas system with pressures usually less than a pound has no valves or external gas supply to maintain.

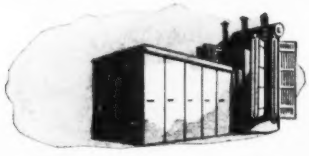


2 COMPLETE IMMERSION in oil helps reduce maintenance of tap-changer and its driving motor. Heavy contacts and quick-break action assure long life. Unit is located in separate oil-filled section of tank equipped with bolted-on gasketed cover.



3 ELEVATING MECHANISM simplifies breaker removal for inspection and test. A by-pass switch can be provided to permit removal of breaker without interrupting load. Either oil-filled or *Ruptair* air breakers are used. In both cases, disconnect fingers on the removable element permit checking without removing breaker from unit.



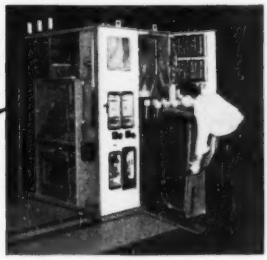


ALLIS-CHALMERS MCS MULTI-CIRCUIT unit substations consist of two or more vertical lift metal-clad switchgear units throat-connected to 1 or 2 transformers. They have the *Oil-sealed* inert gas system for protecting oil and the 32 5/8% step regulator mechanism for ± 10% Range of Regulation. **Bulletin 11B6935.**

Fast Inspection...

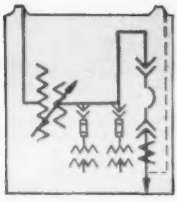
4 DRAWOUT MOUNTED potential and control power transformers permit removal without interrupting service. Smaller door speeds fuse replacement. Current transformers are also accessible from rear. Potheads or bushings or both can be supplied for secondary terminations.

5 DOORS front and rear permit easy access to switchgear, bus connections, *Feather-Touch* control for the tap-changer, potential and current transformers, and other control equipment. These doors are equipped with a labyrinth-type seal to prevent leakage around edges.



6 COMPLETE SWITCHGEAR UNIT can be removed for access to its compartment. This speeds and simplifies painting of compartment interior when required.

ALLIS-CHALMERS SCS SINGLE CIRCUIT UNIT SUBSTATIONS!



EASILY ACCESSIBLE for inspection, maintenance and routine tests, Allis-Chalmers SCS Unit Substations for single feeder applications build customer good-will. Shutdowns are short and infrequent . . . see left how inspections and tests are speeded up.

The weatherproof, modern housing contains all equipment necessary — transformer with ±10% Load Ratio Control . . . the *Oil-Sealed* inert gas system . . . secondary breaker . . . current, potential and control transformers . . . and meters and relays as needed. Installation is simple; a single concrete pad prepared from advance drawings is the only foundation requirement.

HAS 32 5/8% STEP REGULATOR UNIT

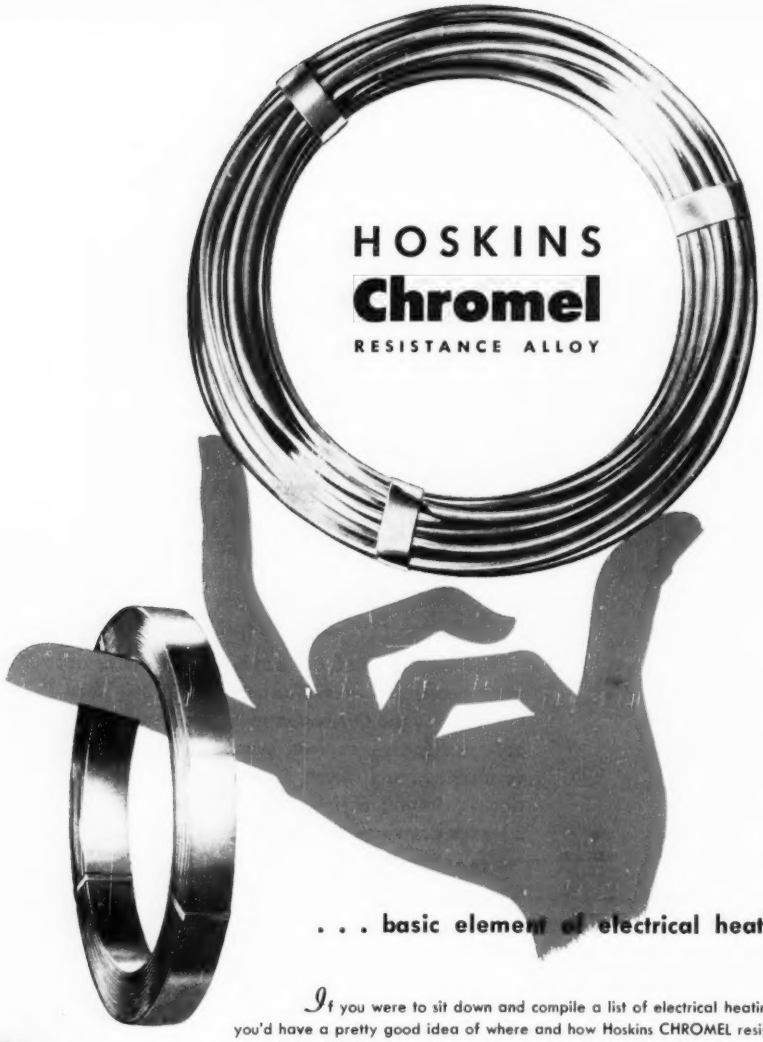
±10% range of regulation is provided by the mechanism that now regulates over 5,000,000 kva in Allis-Chalmers Step Regulators. This range handles more load and holds voltage to a narrower band than ±7½% LRC. As the standard range, it means your cost is less because the savings in manufacturing costs are passed along to you. Call your nearby A-C office for details or write direct. ALLIS-CHALMERS, 932A SO. 70 ST. MILWAUKEE, WIS.

Feather-Touch, Oil-Sealed, and *Ruptair* are Allis-Chalmers trademarks

A 2530

ALLIS-CHALMERS

Pioneers in Load Ratio Control — Originators of 5/8% Step Regulation



. . . basic element of electrical heating

If you were to sit down and compile a list of electrical heating applications, you'd have a pretty good idea of where and how Hoskins CHROMEL resistance alloy is used. For CHROMEL, you know, is the *original* nickel-chromium alloy that *first* made electrical heating practical. It's ductile, durable stuff . . . easy to work with, hard to burn out. Possesses close-to-constant "hot" resistance between 700° and 2000° F. Delivers full-rated power throughout its long and useful life. And, for over 40 years, it's been used consistently and with confidence by leading manufacturers of all types of electrical resistance heating devices. So if you're concerned with electrical heating . . . from a utility load building point of view, as a manufacturer of appliances, or as a user of electric heat in your manufacturing processes . . . your best interests can best be served by Hoskins CHROMEL wire, ribbon or rod. Our Catalog M-1 contains complete technical information . . . want a copy?

HOSKINS MANUFACTURING COMPANY

4445 LAWTON AVE. • DETROIT 8, MICHIGAN

Heating Element Alloys ★ Heat Resistant Alloys ★ Thermocouple Alloys ★ Spark Plug Electrode Wire ★ Special Alloys of Nickel ★ Electric Heat Treating and Laboratory Furnaces

Chromel® nickel-chromium wire

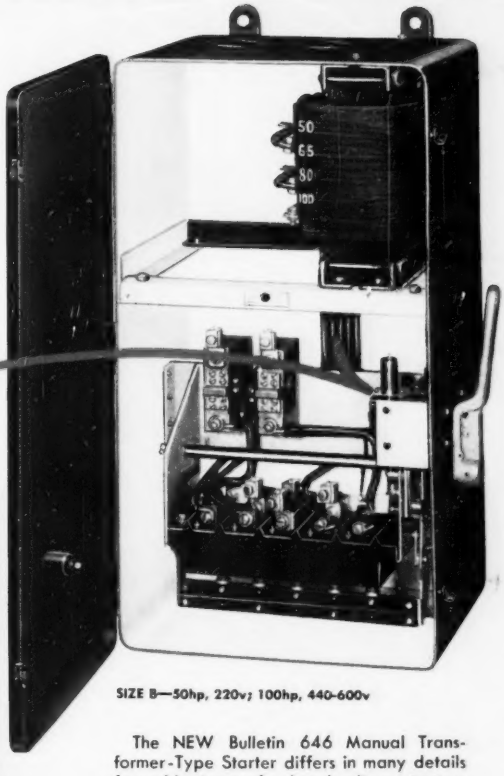
NEW

Bulletin 646

Manual Transformer-Type Reduced-Voltage Starter

Here is the first outstanding improvement in manual transformer-type starters in twenty-five years. It is a worthy addition to the Allen-Bradley line of motor controls.

An unusual feature is its adjustable time delay, which prevents careless operators from switching the motor too quickly to full running voltage. Many other features are described on the next page.



SIZE B—50hp, 220v; 100hp, 440-600v

The NEW Bulletin 646 Manual Transformer-Type Starter differs in many details from older types of reduced-voltage starters.

Time-tested developments . . . like Allen-Bradley double break, silver alloy contacts . . . assure long, trouble-free service. See next page for further details.

Allen-Bradley Co., 1316 S. Second Street, Milwaukee 4, Wis.

ALLEN-BRADLEY

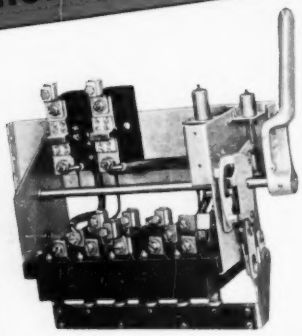
BULLETIN 646 TRANSFORMER-TYPE STARTER

QUALITY

TURN
see next page

EXCEPTIONAL FEATURES *of the*

Bulletin 646 Manual Transformer-Type Starter



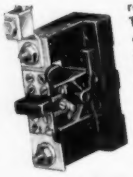
TIME DELAY SWITCHOVER

The Bulletin 646 switching mechanism is a simple, mechanical linkage operated by a two-position, manual starting lever. When the lever is pulled forward, the switch mechanism moves the contacts into the "Start" position. This permits the motor to accelerate at reduced voltage.

An interlock, under dashpot control, prevents the starting lever from being thrown into the "Run" position until the motor has accelerated for several seconds. This timing is adjustable to suit varied starting conditions.

No-voltage protection is also provided by a magnetically operated hold-in latch. Man, motor, and machine are fully protected against accidents and damage from line failures.

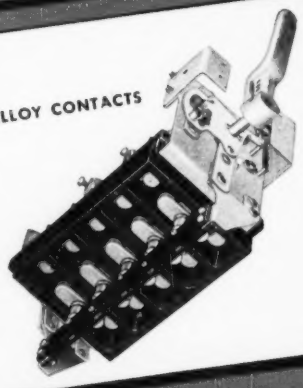
DEPENDABLE OVERLOAD RELAYS

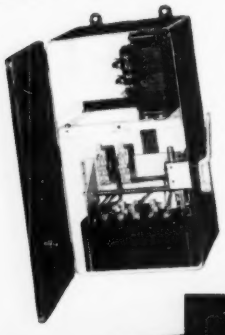


The accurate, reliable overload relays operate on the soldered ratchet principle. They remain reliable in operation, even after long inactivity. Thermal elements available for any load. Contacts are pure silver.

DOUBLE BREAK, SILVER ALLOY CONTACTS

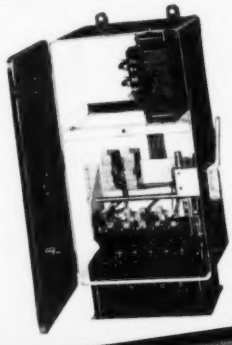
Starting and running contacts are mounted in a molded contact block. Double break, movable contacts are attached to copper spanners, spring-mounted on an insulated rocker arm. In the starting position, the movable contacts bridge the motor and reduced voltage contacts. In the running position, they bridge the motor and line voltage contacts. Easily accessible for inspection.





CAN BE SUPPLIED WITH OIL-IMMERSED CONTACTS

For installations requiring oil-immersed contacts, Bulletin 646 Transformer-Type Starters can be supplied with an oil tank, inserted through the bottom of the enclosure. The tank is suspended on threaded studs, which serve as hangers when the tank is lowered. Since contacts immersed in oil deteriorate much more rapidly than when operated in air, air-break starters are preferable for most applications.



Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wis.

TURN
see front page

Send for Bulletin 646

ALLEN-BRADLEY

Reduced-Voltage Starters for Squirrel-Cage Motors

QUALITY

3 FACTS TO REMEMBER

About Wood Preservation

1 **Creosote Oil, properly applied, makes wood last 3 to 5 times longer. Its deep penetration protects wood from dry rot, termites, fungi and other destructive organisms.**

2 **Creosote Oil is the most widely used wood preservative in the world.**

3 **Pressure treatment with Creosote Oil has been used successfully under practically all conditions for more than 100 years. Its effectiveness has been *proved* beyond the shadow of a doubt.**

Reg. U. S. Pat. Off.

For these reasons, Creosote Oil continues to be the preferred wood preservative of America's leading railroads and utilities for the protection of their huge investments in ties, poles, and structural timber.

For these reasons, also, Barrett continues to recommend pressure treatment with Creosote Oil as the most dependable wood-preserving method. Our half-century of experience is behind this conclusion.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
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FOR a wood preservative that has withstood the test of time . . . that offers you service records of 20 and more years of protection . . . there's nothing like creosote oil.

And for a completely uniform product . . . one that gives you the same excellent results application after application . . . there's nothing like U·S·S Creosote Oil.

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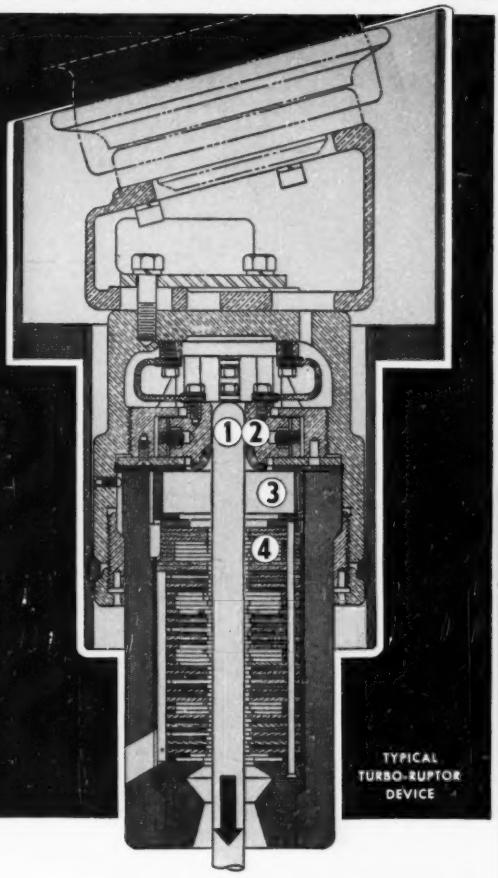
USS **CREOSOTE OIL**
UNITED STATES STEEL

ALLIS-CHALMERS POWER OIL CIRCUIT BREAKERS

How Arcs Speed Circuit Interruption

IN RUPTOR DEVICES

SIMPLIFIED DESIGN ASSURES HIGH-SPEED PERFORMANCE WITH SHORT ARCING TIME



TYPICAL TURBO-RUPTOR DEVICE

WHEN BAYONET contact (1) drops from the stationary contact (2), an arc is initiated in the oil-filled pressure chamber (3). Pressure from the gas generated by the arc causes the oil to swirl down dual helical throat passages (4). These restricted, converging passages force jets of oil into the elongating arc and against the moving bayonet arcing-tip. This turbulent action disperses the arc and waste products, completing interruption at an early current zero.

The simplified *Ruptor* interrupting device has no moving parts to bind or fail. Stationary contact segments provide self-wiping, high pressure contact with the movable bayonet — for low resistance and low temperature rise.

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Ruptor and *Turbo-Ruptor* are Allis-Chalmers trademarks.

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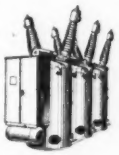
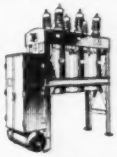
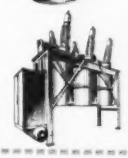
STANDARD RUPTOR OR TURBO-RUPTOR DEVICES ARE USED ON THESE ALLIS-CHALMERS OUTDOOR OIL CIRCUIT BREAKERS



TYPE BZO-160 . . . 69 kv to 230 kv — 5-cycle opening, 20-cycle reclosing.



TYPE FZO-150 . . . 14.4 kv to 46 kv — 8-cycle opening, 20-cycle reclosing



TYPE FZO-151 . . . 69 kv — 5- or 8-cycle opening, 20-cycle reclosing

TYPE O . . . 14.4 kv to 23 kv—8-cycle opening, 35-cycle reclosing

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ONE OF 486
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BURN SO BRIGHT
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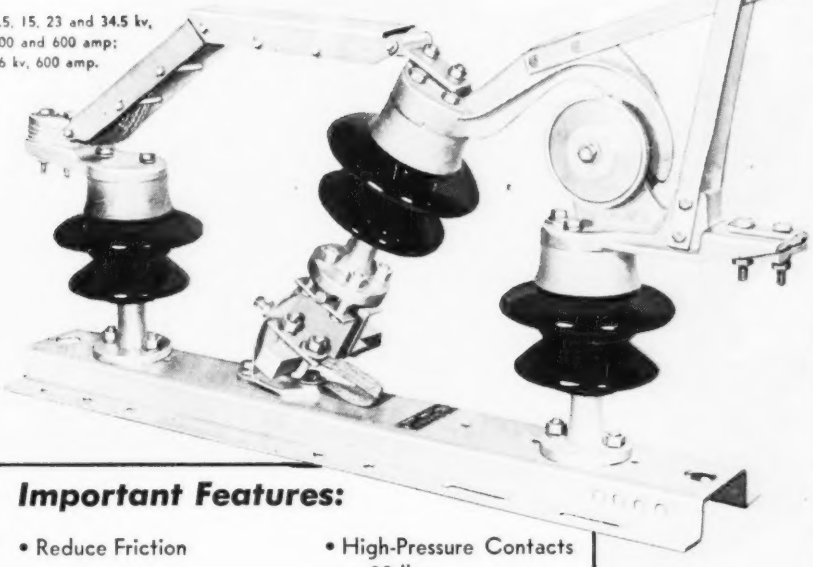
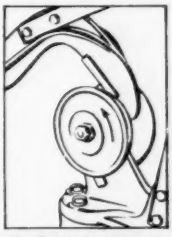
Type SW and SWA Outdoor Air Switches

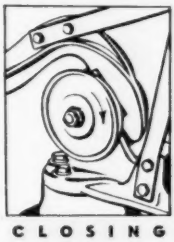
7.5, 15, 23 and 34.5 kv, 400 and 600 amp; 46 kv, 600 amp.





OPENING

Twin discs move upward and revolve when switch opens.



CLOSING

Twin discs revolve when switch closes. Note goose-neck blade that makes lengthwise wipe contact and vertical entry.

ILLUSTRATED ABOVE:

Type SW, 15 kv, 600 amp. Type SWA is similar, two insulators per pole.

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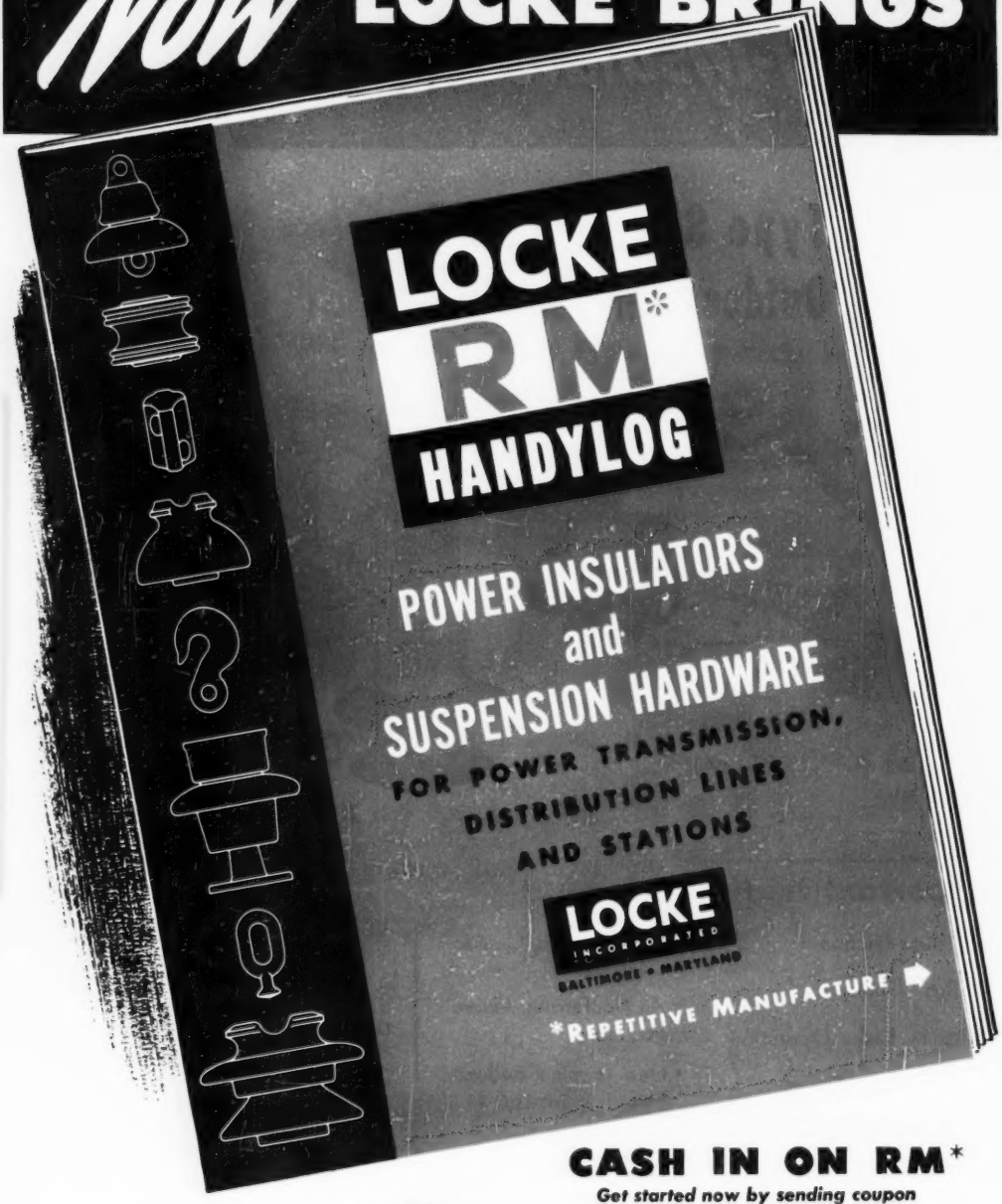

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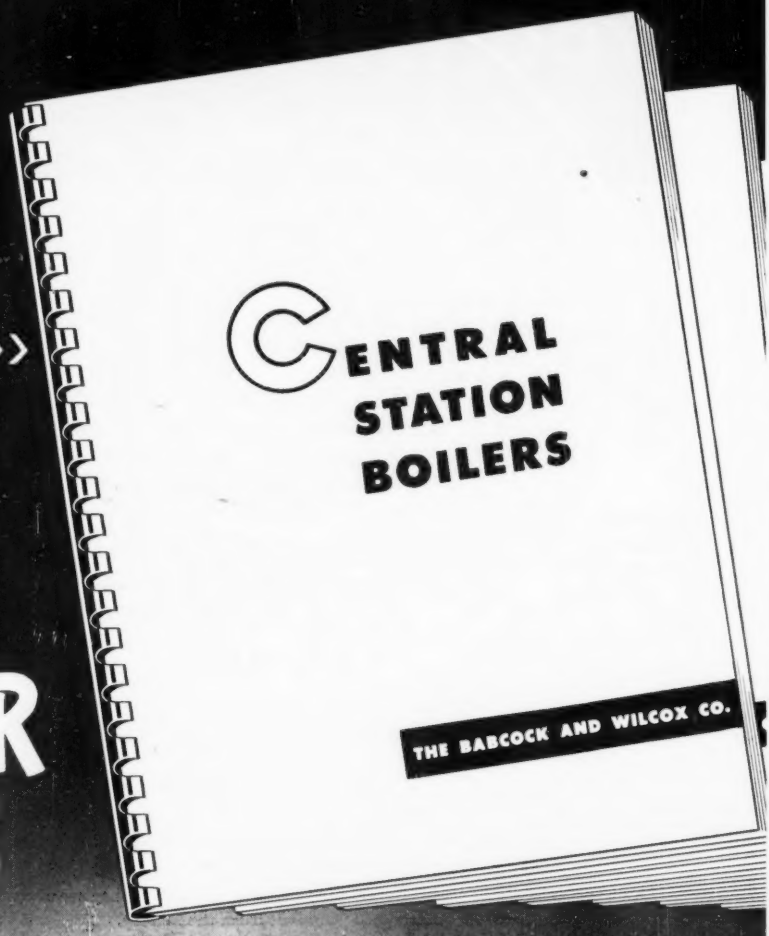
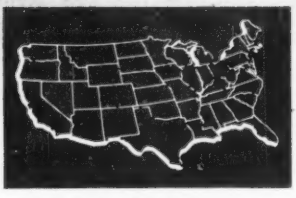
MORE B&W BOILER UNITS

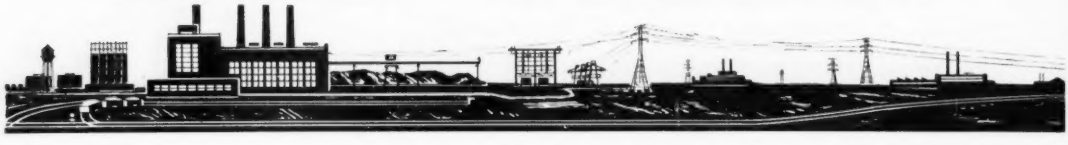


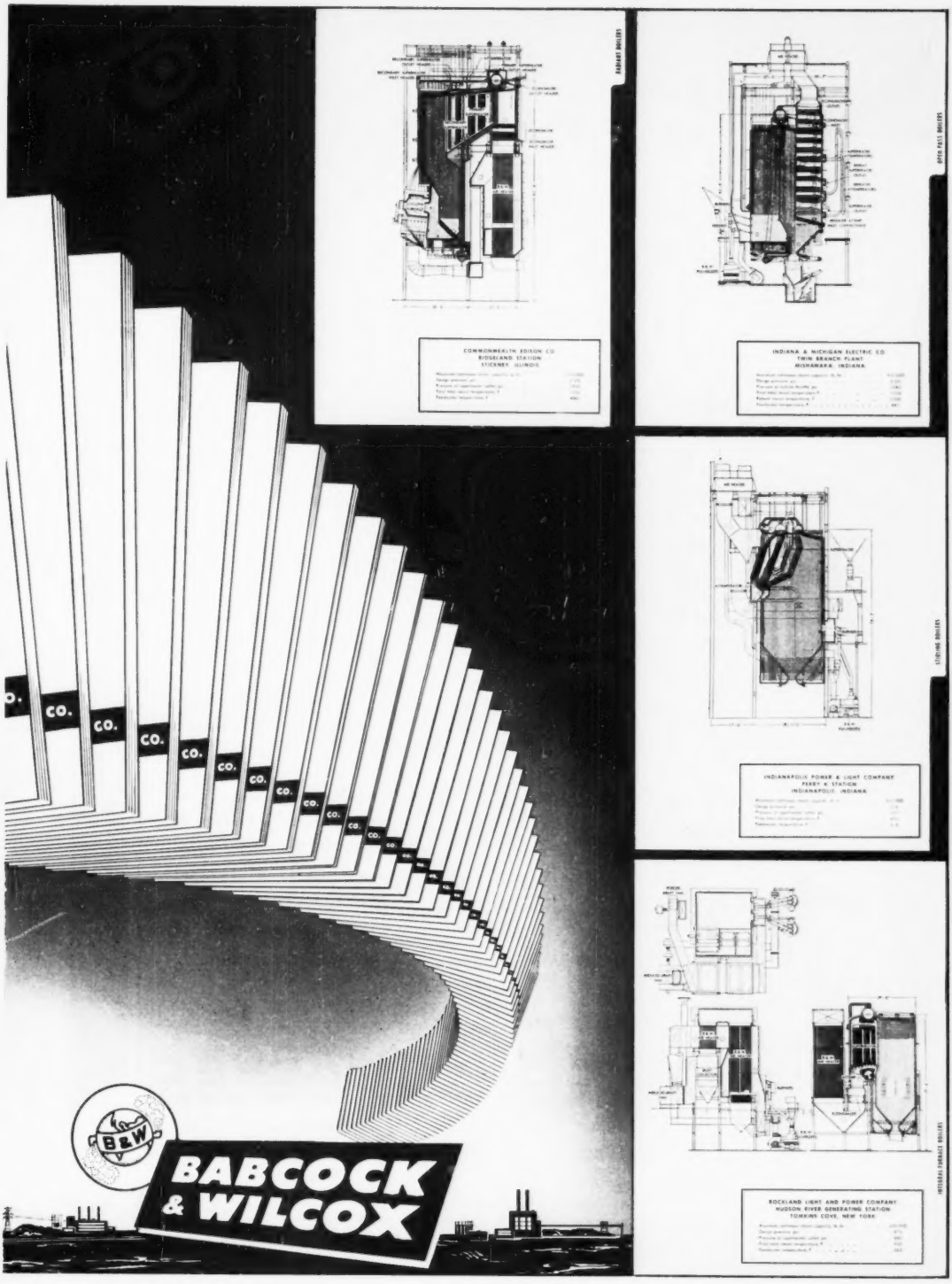
for Stepping Up America's Power



Between the covers of this new edition of "Central Station Boilers" are salient facts about recent B&W designs that are helping to make power more plentiful all over America. Typical units are presented in detailed drawings with their capacities and pressures conveniently tabulated along with names of power companies and station locations.

Send for your copy today. Simply ask for Bulletin G-67.
The Babcock & Wilcox Co., 85 Liberty Street, New York 6, N. Y.

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Fact File on Preheat

No. 4

The free area of the gas and air passages through the Ljungstrom heating elements is maintained at design levels by a simple cleaning routine, accomplished during operation.

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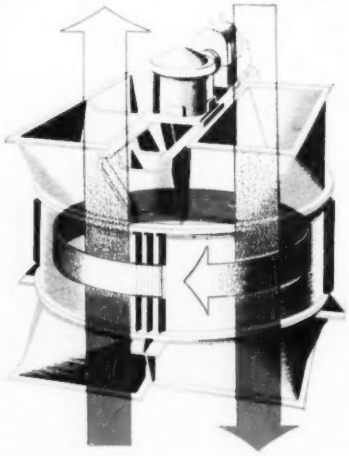

The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

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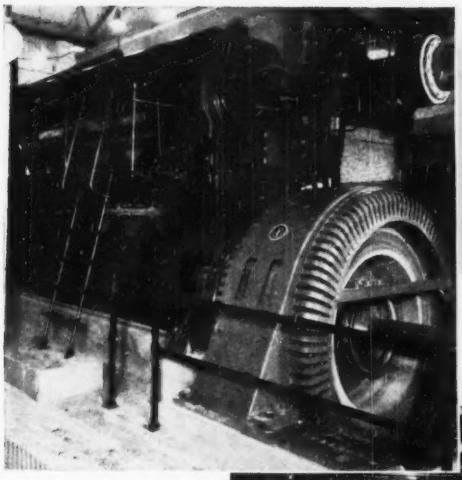
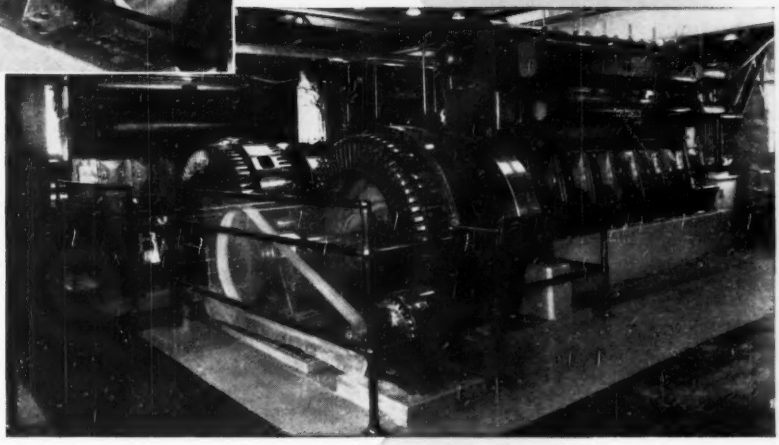


Gold is where you find it



● Seven Superior Diesels helped a midwest quarry company find gold—gold in the form of reduced power costs. In only 12 years the use of Diesels reduced the cost of electrical power $156,000, *after all expenses, including depreciation, were deducted!*

But Superior Diesels supplied more than a low cost source of power—they also provided a dependable one. The engines are operated *at least 16 hours daily, 6 days a week, 52 weeks a year!*

Over and over again we hear similar reports about the outstanding performance provided by Superior Diesels. But that's not strange when you consider that Superior has all of the following advantages: Conservative Ratings ● Fuel Economy ● Precision Bearings ● Heavy Rigid Crankshafts ● Strong Bases and Cylinder Blocks ● Proved Roller Chain Camshaft Drive ● Oil Cooled Pistons.

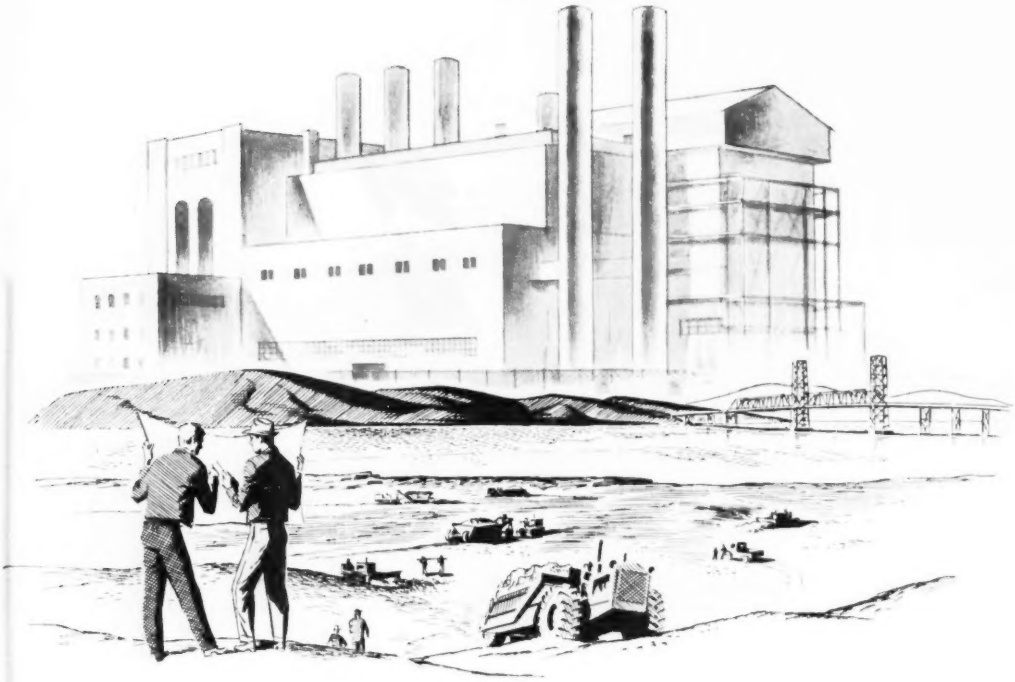
Superior Diesels may be able to help you get gold from your power costs. We would like to discuss it with you—just drop us a line and tell us when it's convenient for you.

THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

THE NATIONAL SUPPLY COMPANY NSCO

Superior DIESEL

THE POWER
Serving Industry



Bechtel engineers and construction crews are at work on another new power facility—one of the nation's largest—a 400,000 horsepower steam-electric generating station.

Utilities engaged in building up power reserves acquire a strong ally in Bechtel Corporation, manned and equipped for the whole job from preliminary study to completed project. Like adding a ready-to-go, experienced department without increasing overhead—engineers pool knowledge and skills with the Power Company's engineers, supplemented by Bechtel purchasing specialists and well-seasoned construction forces.

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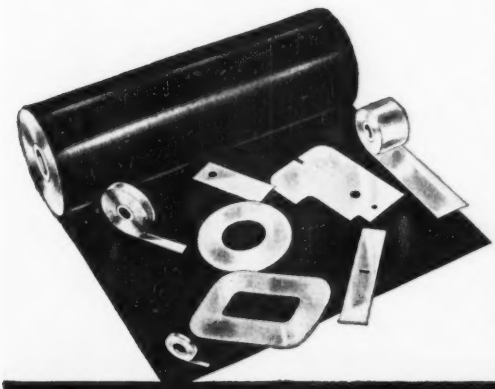

Here's a *new* Irvington insulating material that's important to investigate now. Important because it makes possible the use of Fiberglas (Class B Insulation) at a cost substantially lower than formerly. Important because it provides in a standard product the combination of higher dielectric strength, greater flexibility and high mechanical strength desired in many specific applications.

In making Varnished Fiberglas Style OW, Irvington employs base cloth woven by a new principle that permits the woven fiberglas to carry more insulating varnish. Not only test results, but actual applications have proved its advantages in such services as core wrappings, field coils and punchings. It is available in black or yellow, in thicknesses of .007", .010", .012"; in rolls 25 and 50 yards long; approximately 36" wide; tape in widths from ½" up. Write today for test reports, further details, and samples.

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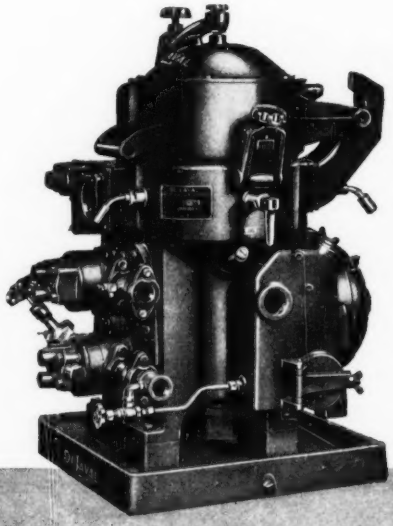
"I am available in a wide range of capacities, enabling every power plant operator to secure the correct unit for his need."

- ***Write for Bulletin TO-1.***



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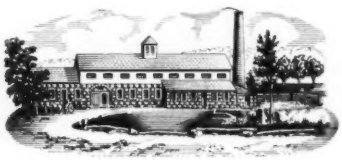

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Senator Needs a Pair of Shoes

THE FEDERAL GOVERNMENT, to our knowledge at least, is not consciously in the business of publishing comic books. But it does unconsciously, as witness the following extract from Pages 343 and 344 of the Senate Hearings on the First Deficiency Appropriations Bill:

Senator Ellender—"I honestly and sincerely believe that electricity can be more cheaply developed and produced by the federal government than it can by private enterprise."

Mr. (P. L.) Smith—"I will grant you, sir, that shoes could be produced and made more cheaply by a city government, a state government, or the federal government if they do not pay their share of the taxes."

Ellender—"But you could not reflect that saving to the public."

Smith—"You could not?"

Ellender—"No."

Smith—"Why not?"

Ellender—"In electricity, everybody uses it; everybody does not use tubing."

Smith—"I said 'shoes.' "

Ellender—"I thought you said 'tubing,' but it would apply to shoes in the same way. In other words, the same thing would apply, in fact, to any commodity."

Smith—"I am amazed at your statement."

Ellender—"It can be more cheaply produced and distributed, and it is a must with us."

Smith—"So are shoes."

Ellender—"Yes."

Smith—"Why does not the federal government make shoes?"

Ellender—"A lot of people can do without shoes and do."

Smith—"They do?"

Ellender—"Yes. We do without them down in our state."

Smith—"That is not for the Northern states."

Ellender—"I might say that I ran barefooted myself until I was 15 years old."

Perhaps so droll an exchange is quite without significance—aside from the demonstration it gives that a United States Senator is so dogmatic on a public issue that he'll stick to his position even though he makes himself ludicrous in doing so. But consider that exchange in the light of another extract from some much more significant comment on the same issue. Here's one point from NSRB Power Consultant Edward Falck's Midwest Power Conference paper:

"It seems to me that if all the brains—legal, engineering, and public relations—that are now being devoted by both sides to the ideological public-private (power ownership) battle could by some means be channeled into more constructive purposes of improving the size, scope, and quality of the electric industry, there would be a very clear gain to the country as a whole."

There just can't be any question as to the accuracy and wisdom of Falck's statement. Nor can there be any question as to the unreasoning dogmatism of Ellender's comment.

Trouble is, this issue is being fought primarily in the Congressional arena, particularly in the Senate. And when you enter the Senate, Ellender has one vote and Falck has none. You might say that dogma has one vote and qualified intelligence has none. And you wouldn't have much to be concerned about, at that, if dogma had only one vote.

We wouldn't suggest for a second that the answer is to run the country solely through the decisions of the especially qualified, highly trained Falcks and to exclude from government the Ellenders, who ran barefoot in fact until 15 and have yet to wear shoes on their intellects on many of the intricate, overpowering issues that face Congressmen every day.

But isn't it going to be difficult to adopt the rational approach Falck suggests so long as the issue he would resolve is controlled by the Ellender approach to it?

Lines Are at Stake

THAT STRUCTURAL nightmare, the television antenna, is turning out to be much more disturbing to utility operators than a bad dream. Built and installed as they are today, they are an active threat to life and property.

Resembling nothing quite so much as a broken bedspring on a broom, most television aerials have about as much structural stability. This of itself is sufficient cause for alarm. But the hazard is compounded when ignorant or irresponsible installers slap them up on chimneys and apartment house roofs to weave drunkenly a scant feather's fling from energized distribution feeders.

One metropolitan utility recently counted 13 such video vagaries swaying above energized 12-kv lines.

There is little need to lay down here the multiple hazards that such situations comprise—to the safety, property, and comfort of the public.

We do not pretend to pass here on the legal question of who is liable should injury or damage follow the fall of such a device across energized lines.

Such a question may never have to be decided by the courts if utilities and municipal agencies move now to seek out potentially hazardous installations and to sponsor statutes and amendments to building codes that will stop erection of such devices near high-voltage lines.

It would help, too, if the infant video industry would take steps to educate installers about this potential hazard.

Crane Hazards

TWO OR THREE states now have laws or regulations aimed at preventing the injuries that happen when a crane or well-drilling rig is maneuvered into contact with a power line. Power lines are raised high enough to leave plenty of clearance for vehicles and moving objects of normal height. But despite this long established safety precaution, once in a while some unmindful operator will swing a boom into a live power circuit. It has just happened again, this time in New Jersey.

All the details are not available, but it is practically certain that the contractor or operator violated one or more provisions of New Jersey's recently promulgated rules pertaining to such industrial situations. The Department of Labor's recent safety orders stipulate "precautions to be taken in the proximity of high-voltage lines" based on the 1948 legislative provisions. The departmental orders carry administrative regulations prescribing that the person responsible for operations near power lines shall notify the utility so that barriers, deenergizing, or other measures can be employed to protect the line and the operation.

In this way these ordinances and rules aim to bridge the no man's land that was the free field of operation of the roving and unpredictable mover, shovel operator, or well-driller. The onus now is on him to report his plans and his scene of intended action before he starts. Every other state needs comparable safeguards.

Obsolescent Generating Equipment?

THIRTY PERCENT of the utility steam generating capacity (in kilowatts) now operating was installed and operating before the end of 1925. Three kilowatts in every ten are therefore at least 23 years old. One in every eight kilowatts in service at the end of 1948 was installed before 1920 and is therefore at least 28 years old. In fact one in 20 dates back to 1915 or earlier.

Those are the statistics on an age basis—one that is admittedly no criterion for scrapping if the equipment is still functioning economically as to fuel consumption, operation, and maintenance. But if those operating costs are demonstrably disadvantageous, then it can be a matter worthy of analysis that practically half the electric utility generating capacity is 20 or more years old, as Federal Power Commission statistics show.

Just how much has the improved fuel economy of new plants, built at substantially greater cost, made the much earlier plants economically obsolete?

Over the years the advances in design have consistently succeeded in keeping the newest and best plant of each 5-year interval at an achieved new level of performance such that its fuel per kilowatthour ranged from 48 to 71% of the average performance of plants then operating. The general average over the years is about 60%. That is, the plants in operation in almost any year have required 66% more coal for each kilowatthour they turned out than the very latest plants or units added. Of course, this does not mean actual coal tonnage is that much above best obtainable performance because the older plants are worked less.

It is not necessary to make too many broad assumptions to assert that (except for the lean 1931–35 years) the electric utilities could have saved 16 to 20 million tons of coal a year almost any time between 1916 and 1945 if they could possibly have scrapped all the plants more than 5 years old—so much has been the thermodynamic betterment in performance, year by year. Some 46 million tons could have been saved in 1948 if all the newer plants could have functioned at the 0.71-lb. rate reported for the best plant and all those of vintage earlier than 1945 with even a 1.34 average rate could have been superseded.

It is ridiculous to talk in such terms as to scrap 30 million kw for the sake of a coal saving that might buy only 2 million. But it is not ridiculous to suggest putting those 2 million kw or more on the docket for critical analysis. A few of them may be found to be eating up, in long coal rate for short hours and maintenance for readiness-to-function, more dollars than would warrant their retention. If so, then out they should go as soon as the boiler and turbine manufacturers' factories and the utility till respectively can alike stand the strain of increased equipment production and purchase.

The situation is no different from that of the farmer who has a horse he uses only to bring in the hay crop each summer. He concludes the animal is "eating his head off" if the winter feeding of oats costs him more than he gets for the hay. That's why tractors supplant horses.

The Electrical Week

The boom market in common stocks of electric utilities apparently will stay around for a longer period than expected. By the middle of June the industry had reached 47% of its goal for the year. Prospects for sales in the second half of 1949 are pronounced favorable . . . The Kentucky PSC, finding itself in between a co-op and a private utility who wish to buy the same property at the same price, is beginning to wonder if it legally has the power to rule on sales of utility property . . . A demand for energy estimated in the millions of kilowatts is foreseen for the government's program of aircraft and missile research. And no generating plants are to be built to supply the power, which will be needed for only short periods of time . . . REA has extended another loan to a generating co-op. This one is in west-central Michigan . . . And in Arizona, Central Arizona Light & Power Co will buy the Arizona Power Co and set up a wholly owned subsidiary to serve the northern part of the state.

If you haven't already guessed why output has been declining, these preliminary sales figures for April may help. Residential sales were up 14.2% over the corresponding month of 1948, small light and power sales were up 5.8%, but large light and power sales (in 1948 over half of all power sales) were down 0.1%.

Grand Coulee Dam was used for flood control this spring for the first time, Col Theron D. Weaver of the Army Engineers reported recently to the Columbia Basin Interagency Committee. He said the relatively small amount of flood control storage at Grand Coulee that can be used lowered the Columbia 0.8 ft at Portland.

During 1948, The Cleveland Electric Illuminating Co sold more than 4 million lb of scrap for more than $200,000.

One of the largest appliance manufacturers will swing out of radio and concentrate on television next year. It believes better demonstration possibilities will improve sales results.

Washington Water Power Co has an expansive program to aid farm youth. It includes college scholarships for needy farm youth, short course scholarships for those desiring to study agricultural subjects, and expense funds for 4-H Club leaders desiring to take leadership courses at a state college or university.

A recent New York Times story claimed that Long Beach, Calif., is slowly sinking into the ocean. On the sinking land are the Long Beach plants of Southern California Edison Co. These, the paper asserted, have dropped about 9 ft but slowly and without any damage to the structures.

One of the fastest growing associations in the industry is the Public Utilities Advertising Association, which also includes gas companies in its membership.

European utility men, who have just completed a tour of American utilities and manufacturing plants under ECA sponsorship, were more impressed with the voluntary interconnections established by American utilities than with anything else they saw. All wish to establish similar interconnections in their home countries.

Based on the April rate of consumption, coal stocks on hand at electric utility power plants on May 1 were sufficient to last 118 days, compared with 100 days a month earlier and 57 days a year ago.

Notes From The News

Electric customers of Georgia Power Co have passed the 400,000 mark. At the end of May the total was 401,509 . . . Yakima and Walla Walla have asked a court test of the Washington law permitting two or more PUD's to buy and operate private power systems . . . New York City has renewed for three years its 3% tax on gross receipts of utilities . . . Pennsylvania Power & Light Co claims that 97 out of every 100 farms in its area have electric service available . . . ELECTRICAL WORLD has won a merit certificate in the contest sponsored annually by Industrial Marketing. The award was made for the story "AIEE Sessions Stress Improved System Techniques," which appeared in the Feb. 14, 1948, issue. The story represents the joint efforts of EW's engineering staff . . .

During a 30-minute power failure that cut off lights in three Sioux City, Ia., hospitals, a son was born to Mr. and Mrs. Erling Berget. The father is an electrical engineer . . . Dearborn Hall, new electrical engineering building at Oregon State College, was formally dedicated May 28. Dean George W. Gleason presided at the ceremony, attended by the Portland section of the AIEE . . . Springfield, Ore., will vote June 24 on a proposal to

Continued on following page

ACSR IS NOW coming in volume quantity from the Reynolds Metals Co. In the foreground are 40-in. reels of No. 4 (7 aluminum/1 steel) cable. In the background are 250-lb coils of wrapped cable. This is part of the first shipment to REA cooperatives under the contract with the Wisconsin Electric Cooperative. April shipments by Reynolds of ACSR totaled 447,170 lb. Production is now according to schedule

establish a $800,000 municipal power system, to be financed by revenue bonds payable in 20 years. Electricity would be purchased from the Bonneville Power Administration. Mountain States Power Co now holds a long-term franchise from the city, but the proposal makes no reference to purchase of its facilities.

Financial:

Rep Emanuel Celler has demanded that the New York Public Service Commission withdraw its authorization for Long Island Lighting Co to sell $16 million in debentures to four large insurance companies. He said the insurance companies soon may "own most of our public utilities—lock, stock, and barrel" if some curb is not placed upon their purchase of debentures and other issues without the necessity of competitive public bidding and Securities and Exchange Commission registration . . . Central Arizona Light & Power Co's common stock now has a par value of $5 a share instead of no par value. The change in the articles of incorporation adopted at the annual stockholders' meeting, became effective June 7.

Public Service Co of Colorado stockholders have approved an increase in the company's authorized capitalization from $50 million to $75 million par. This would add 625,000 common shares and 125,000 preferred . . . Offering is expected late in June of $80 million in new first and refunding mortgage bonds by Pacific Gas & Electric Co . . . Houston Lighting & Power Co expects to offer stockholders the right to subscribe either to additional shares or to debentures convertible into common after Jan 1, 1950. Holders will be invited to subscribe to stock at $40, one for four, or to $50 in debentures for each four shares of common held.

Public Service Co of New Hampshire has received SEC permission to offer competitively $4 million of Series E first mortgage bonds, due 1979. Proceeds, together with funds from the sale of 104,804 shares of $10-par common stock, will be used to reduce short-term bank borrowings . . . Mexican Light & Power Co. Ltd. is planning to reorganize to strengthen its capital structure as a qualification for a long-term loan of $26 million from the International Bank for Reconstruction and Development. The bank already has granted the company a short-term loan of $10 million at 5¼% annually to help the reorganization . . . Plans for sale of 251,033 additional shares of common stock have been announced by Portland General Electric Co. Proceeds of the sale, expected to be about $6 million, will finance the company's current construction program. Total shares outstanding will be 1.25 million.

Legislation:

Bowing to a flood of opposing telegrams, the Florida House has "indefinitely postponed" the bill giving Tampa Utility Board power to take over Tampa Electric Co and all its Hillsborough County properties without referendum . . . Delaware's legislature has approved a measure calling for creation of a state Public Service Commission, effective Sept 1. Members will receive $4,500 a year . . . Organized labor in Missouri has refused to accept two recently introduced amendments to the Cooper Bill, designed to replace the King-Thompson anti-utility strike law. In practical effect the amendments provide for compulsory arbitration and authorize injunctions if the arbitration's board's findings are not accepted. They set up standards to be followed by the arbitration panel in an effort to avoid any attack based on the recent court decision voiding a similar New Jersey law.

Seller's Market in Common Remains

New Equity Sales Through June 15, Exceed 47% of Industry's Goal for Year: First Six Months of 1949 Likely to End with $182.5 Million in New Money

THAT SELLER'S market in new electric utility common stocks which came with the first days of spring seems to have decided to stay.

By June 15, 1949's first half had seen new equity sales of $152,667,000. These exceeded 47% of the industry's common stock goal, as expressed in an ELECTRICAL WORLD survey late last year. Prospects that sales would be over half the year's program by the end of June were good, for issues registered and approaching sale last week were expected to bring in another $27.2 million. In addition, there was another issue in the planning stage likely to be sold or on sale during the first six months of 1949. It should bring $2.6 million.

$182 Million Likely

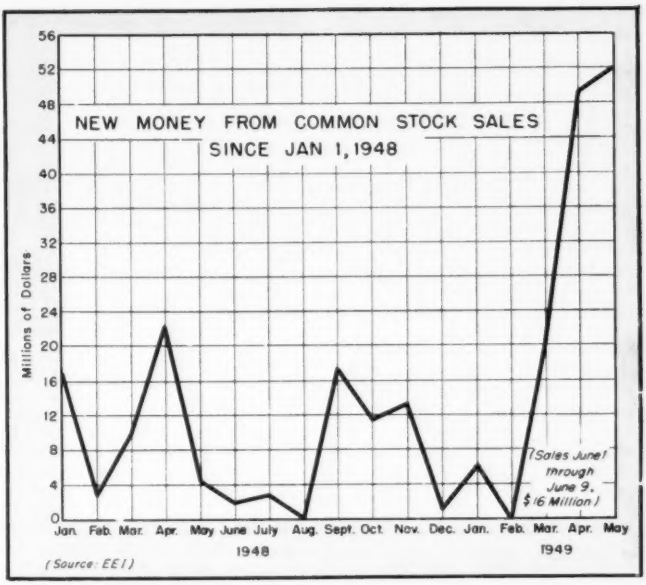
If sales in these last two categories are realized, the first half would close with $182.5 million of new risk capital in the till. That wouldn't be at all hard to take, considering the "buyers-market-recession-capital-shortage" nature of the times. And there is planned for the first few days of the second half yet another big common issue which should yield about $19.5 million.

This would make 76.6% of the $322.9 million the industry figured it would raise from new equity issues this year. And the progress to date is a far cry from last year's common stock sales—even farther from those of 1947. Then, of course, the drive for new money was considerably less stringent and the debt-equity ratios had been relatively untouched by the splurge of bond selling which has marked utility financing of the last two years.

Outlook Bright

Perhaps the most satisfying aspect of today's utility equity picture lies in the outlook for the last half. The market's gyrations—not to mention those coming out of Washington—have the street in an "iffy" mood. But if you are brave enough to assume that the conditions affecting the sale of electric utility common stocks which have prevailed for the first half will continue through the second, you can find responsible people who believe firmly that the new risk-money-raising pace of the first half will go right on unchecked.

Certainly there won't be any dearth of new issues, according to the experts, and assuming again that conditions continue favorable. Many companies are doing the pre-registration groundwork right now. Others are watching the market closely to see if it's true what they say about utility equities. There'll be a turndown, of course, in July and August. But come September with an attractive market, the lost ground could be made up fast.



Backing up this pleasant outlook are five factors, according to Harold H. Young, a partner of Eastman, Dillon & Co. For one thing, investors seem to regard the utility industry as a promising storm cellar for a time when industrials are having their troubles. The steadier nature of utility earnings is perhaps the prime factor in this feeling. There's also the diversity in revenue sources which utilities have and the fact that industrial load declines cost utilities least, per unit sold.

Then the anticipation is for good earnings in 1949. Earnings for the first quarter were nicely ahead of the comparable period in 1948, under the impact of rate increases, a downward trend in fuel prices, and the operation of new, efficient equipment.

Industrial business was off, to be sure. But at least one of the country's largest operating companies had long been in a position where it could earn more money for the common stockholder by losing 50,000 kw of industrial load than it could by serving that load. Losing that kind of business—even if that's an unusual case—won't hurt the net earnings picture. And bond money, which has paid for the largest part of the industry's expansion so far, has been cheap throughout.

A third factor that helps the last half's outlook for utility equity sales is the presence in the market of a number of institutional buyers—investment trusts, fire and casualty insurance companies, educational institutions, and trust departments of banks.

Some of these have been boosting the proportions of utility equities in their portfolios as the prospects for industrials sagged. Conversely, of course, if the industrials begin to go somewhere, these potential customers are likely to edge out of the utility market. That's a major "if" in the outlook for the last half.

Yields on utilities are good. They aren't up to the 8-10% you can pick up

on some industrials, of course. But the earnings prospects look better—the storm cellar aspect again—and there is a higher percentage of net income being paid out.

The much higher payout ratios of the power business constitute another strong point for additional common stock sales by the industry. In 1948, 70% of the net earnings went to the shareholders. For all corporations, it was 39%. That doesn't leave much choice for the investor who's buying yield, particularly if he's willing to sacrifice a percent or two in the yield for the stability of utility securities. And the anticipation, in view of the better earnings this year, is that utilities will hold or even increase dividends.

Apparently those relatively high yields—for utilities—still keep some systems unhappy about the sale of common stocks, particularly when they think back to the prices and yields they could obtain in 1946. But today's splurge of utility equities wouldn't be possible if the yields were as low as they were then. There's too much competition from good industrials at 10% for utilities at 5. And, as Young points out, the relatively high yields of utility common are offset by the low interest rate on utility bonds.

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Kentucky PSC Ponders Over Its Own Powers

Does the Kentucky Public Service Commission have the statutory authority to rule on sales of utility property? The commissioners themselves would like the answer. In the past the Commission often has approved the application of a party to buy a utility. But did the Commission have the legal authority to do this?

What is bothering the PSC is the sale of the Rural Electric Service Co, Calvert City, owned by L. A. Solomon. The Kentucky Utilities Co and Jackson Purchase Rural Electric Co-op, Paducah, have both offered $78,000 for the property. Both have petitioned the PSC for permission to make the purchase.

A recent decision by the United States Court of Appeals in Washington held that a regulatory board is limited to the powers given to it by the legislative body, no matter how many unchallenged times it has exercised an authority not given to it. If this should also prove true in Kentucky, the Commission could gracefully step out of its dilemma.

The co-op asserts the Commission has the right to designate the buyer. KU argues that the statutes are silent on the Commission's sale-of-property jurisdiction. KU's counsel argues that its petition is mostly an advisement of intent to purchase. This procedure (petitioning) is a customary rather than a required one, he claims.

At present Rural Electric serves about 700 customers and buys all its power from Kentucky Utilities. But two large industrial plants are being built near Calvert City; and although they will buy power from TVA, the new residential areas which will arise will probably get power from Rural Electric. Jackson Purchase is now buying its power from KU but asserts that it will soon be able to get TVA power. Calvert City is only 2 miles west of TVA's Gilbertsville Dam.

GEORGE H. BLAKE, left, president of Public Service Electric & Gas Co, and Gov Alfred E. Driscoll of New Jersey examine a bearing thermometer on a turbine at Sewaren Station of the company. Both were on the program at the formal opening of the station on June 8. The plant now has a capacity of 200,000 kw in two machines. Another 100,000-kw unit will go on the line in fall, the fourth is on order. The steam turbines are the first to operate with steam at 1,050 F. Sewaren will raise system capacity to 1,615,300 kw

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Will Overhaul Generators

Funds for a complete overhaul of the three 20,000-kw generators in the Gorge powerhouse of Seattle City Light have been appropriated by the City Council.

The overhaul, first in 25 years, is possible because the entire plant at the Skagit has been shut down since May 1 to permit construction work on the tunnel that delivers water to the turbines. The powerhouse also is being enlarged to accommodate a new 10,000-kw generator. The shut down is expected to continue until about Oct 1.

Canadian Light & Power Offers Dissolution Plan

Canadian Light & Power Co will ask its stockholders this month to authorize the company's dissolution.

Under the dissolution plan Canadian Light, a joint subsidiary of Quebec Hydro-Electric Commission and Shawinigan Water & Power Co, will scrap its 28,000-hp hydro plant on the St. Lawrence River at St. Timothee, Que. Quebec Hydro-Electric will redeem $2,519,700 in 5% first mortgage gold bonds of the subsidiary in return for all immovable assets, $88,000 now held in trust for the bondholders, and all benefits of Canadian Light's operations in the six months ending July 1.

Remaining assets, after provision for current liabilities and costs, will go to the subsidiary's stockholders. They are expected to get between $25 and $27 a share.

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Pay Boosts of 5% Given

A new contract has been signed by Gulf States Utilities Co and Gulf States Electric Service Employees Association, an independent union, calling for pay increases of 5%. An additional holiday and changes in working conditions are also included in the two-year agreement, effective May 1.

MOCCASIN BEND Substation of the Tennessee Valley Authority is tied into the TVA system to make available an extra 60,000 kw of capacity to the system of the Electric Power Board of Chattanooga. Left to right are States R. Finley, general superintendent, Electric Power Board; L. J. Wilhoite, EPB chairman, getting ready to pull the switch; G. O. Wessenauer, TVA power manager; and Merrill DeMerit, TVA chief power engineer

Aircraft, Missile Research Program Will Demand Millions of Kilowatts

VAST NEW blocks of electric energy—estimated in millions of kilowatts—will be required for the government's program of aircraft and missile research in the next few years.

Authorizing legislation already has gone through committees of both the House and Senate. It calls for a total outlay of more than $161 million for new research facilities to be built by the armed services and the National Advisory Committee for Aeronautics over a period of about six years. The combined agencies hope to start construction next year.

Chief power consumer along the proposed installations will be the 22 transsonic and supersonic wind tunnels contemplated in the program. Least important of these—power-wise, at least—probably will be the 13 tunnels to be erected at colleges and universities selected by NACA. These will be small units, designed for the training of engineers and physicists. Six larger units will be installed at existing NACA installations at Langley Field, Va., Cleveland, and the Ames Laboratory near San Francisco. Another will be installed by the Navy at Carderock, Md.

But the major potential power demand is anticipated at the Air Force's proposed air engineering development center. The site of this project has not been selected. But the Air Force estimates its "possible future" electrical energy needs at 1.3 million kw. Two giant wind tunnels probably will account for most of the energy required at the $150 million installation.

Though the Air Force cannot select a site for the development center until the project has been authorized, its location necessarily will be in the West. For tests of rockets and guided missiles, a large area of public land, not to be found in any other region, will be required. In addition to the enormous power requirements, it is estimated that the center will require upwards of 30,000 acre-ft of water a year, largely for cooling purposes. These requirements point to eventual selection of a site near a federal multiple-purpose dam—but it will have to be one of the largest.

Air Secretary Symington has advised Congress that no electric generating facilities will be built by the Air Force. If started next year, the center's maximum peak energy demand will mount to 237,000 kw by 1955, he said. Power supply requirements of the center would present unique problems since the wind tunnels and other equipment probably would be operated only at intervals of unscheduled duration.

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Franchise Extended

Dade City, Fla., has extended the franchise of the Tampa Electric Co another five years from Sept 1, 1953. Under terms of the extended franchise the price of energy sold to the city has been cut from 4 to 1.5¢ per kwhr, retroactive to Sept 1, 1948. The company will also furnish half of the overhead street lights without charge.

Holyoke Water Power Co Favored to Build Project

Holyoke Water Power Co has won the first—and perhaps last—round of its battle to build a hydroelectric project on the Connecticut River at Holyoke, Mass.

The City of Holyoke Gas & Electric Department proposed to erect the power plant at an existing dam owned by the company. But since a Federal Power Commission examiner recommended last week that the company do the job, the city has made no further showing. The Gas & Electric Department must formally protest to FPC by June 25, deadline for filing exceptions to the examiner's decision, or face the likelihood of losing its bid.

Examiner Max Baron's initial decision came after protracted hearings in Holyoke and Washington, D. C. Plans of the company and the city originally were substantially alike, each contemplating an ultimate installation of 60,000 kw. Then during the hearings the city eliminated from its plans the canal system operated in conjunction with the project.

The examiner ruled that (1) abandonment of the canal system would not be in the public interest; (2) the city's plans would not result in an economically feasible project; (3) the city lacked legislative authority to construct, operate, or finance the project, which would be outside city limits.

He recommended that the company be granted a 50-year federal license. If the city files no exceptions, FPC may take up the matter or let the examiner's ruling stand.

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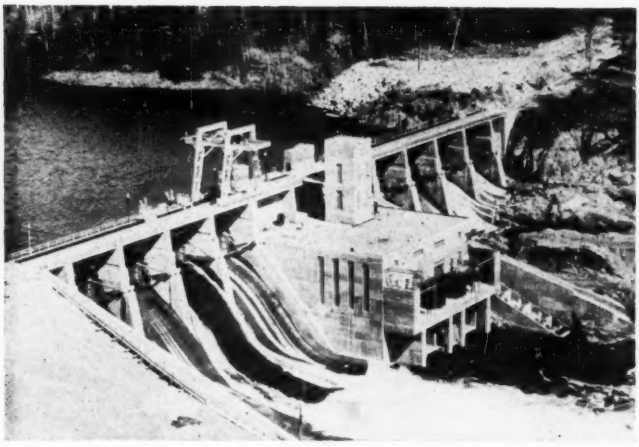
GRDA Ends Struggle by Buying Competitor

Grand River Dam Authority, an Oklahoma agency, and Grand Hydro, Inc, a private company, have settled their differences. GRDA has purchased all of Grand Hydro's assets for $931,000 including $281,000 previously paid.

Grand Hydro in 1931 received a state legislative permit to use Grand River waters for power generation. The company had only completed survey work in 1935 when the state gave GRDA complete right to the river's waters. GRDA immediately condemned the land of Grand Hydro.

In the following court action Grand Hydro was supported in its claim that the land should be valued for its power potential and not just as farm land as GRDA contended. A value of $800,000 was set on Grand Hydro's land. This award was in the purchase price.



SKELTON STATION of Central Maine Power Co on the Saco River near Biddeford has a capacity of 16,800 kw. A fish ladder beside the log sluice is a feature of new project

REA-Financed 'Super-Cooperative' Formed in West-Central Michigan

ANOTHER "super co-op" has been formed by Rural Electrification Admintion-financed rural power systems, this one in west-central Michigan. It will take over the generating and transmission requirements of three established electric distribution co-ops operating in 21 Michigan counties.

REA announced loans totaling $6,429,000 last week to the new Wolverine Electric Cooperative of Newaygo, Mich., and three member distribution co-ops. Of the total, $5,532,000 was allotted to Wolverine for new generating units with a combined capacity of 11,700 kw and for 347 miles of transmission lines.

The Michigan loan was followed this week by an REA allocation of $4,065,000 to the Central Iowa Power Cooperative, another "super co-op." Central Iowa previously had received REA loans totaling $6.1 million for generating and transmission facilities to serve eight distribution co-ops. Under a unique contract arranged in 1946, all the Central Iowa properties are to be operated by the Iowa Electric Light & Power Co.

On a now familiar tune, REA reported both loans were necessary because the present power supply in each area had proved "inadequate." Spokesmen for the lending agency continued to predict that a "critical power shortage" looms for many REA-backed systems next winter.

The new Wolverine co-op will take over five small generating plants now operated by the Tri-County Electric Cooperative of Portland, Mich., and the O&A Electric Cooperative, Newaygo. These plants have a present total capacity of 10,379 kw. Wolverine will increase the capacity of three plants, adding four 2,500-kw units and a 600-kw unit at O&A's Hersey and Burnips stations and a 1,100-kw unit at Tri-County's Portland plant. In addition, Wolverine will build a transmission system to interconnect the plants and tie in with the distribution systems of O&A, Tri-County, and the Oceana Electric Cooperative of Hart.

The three distribution cooperatives shared $897,000 of the total Michigan loan to finance new line, system improvements, and other requirements.

Chief venture financed by the Iowa loan was the installation of a second 20,000-kw steam generating unit at Central Iowa Power Cooperative's Cedar Rapids plant. The initial 20,000-kw unit is scheduled for operation late this year or early in 1950.

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Municipal Boosts Wages

Manual employees of San Antonio (Tex.) Public Service Board have been granted a wage increase of 5c an hour, effective July 1. About 850 workers are affected.

Central Arizona L&P Co Establishes Subsidiary

Central Arizona Light & Power Co, Phoenix, will buy the Arizona Power Co, Prescott, and will operate it as a wholly owned subsidiary to be known as the Northern Arizona Light & Power Co. The Arizona Corporation Commission has already granted its approval.

Commission Chairman William T. Brooks favored the proposal because:

1. There is a definite need for better service in the area now served by the Arizona Power Co.

2. Service has not been satisfactory because of the lack of financing and lack of a firm power supply at a reasonable cost.

3. Under the agreement service should be materially improved because Central will be able to supply the power needed by its subsidiary at a reasonable rate.

Under the agreement Central will advance between $400,000 and $500,000 for the new company's stocks, adjustments, and other assets. It will also assume $3.6 million in Arizona Power Co obligations. Arizona Power would retain ownership of two hydroelectric and a steam generating plant and would be paid $250,000 a year on a 30-year lease.

Arizona Power has approximately 13,500 customers. It serves the northern part of the state except a small area served by cooperatives. Central Arizona has over 55,000 customers.

William P. Reilly, president of Arizona Power, will become vice-president and general manager of the new company.

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Sale of Lines Approved

Federal Power Commission has authorized Carolina Power & Light Co and Roanoke River Power Co to sell transmission lines in Virginia and North Carolina to Virginia Electric & Power Co. It also okayed merger of these purchases with Vepco's present facilities. A total of 18½ miles of line is involved.

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Named MacArthur Aide

Calvin W. Verity, Middletown, Ohio, industrialist, has been appointed director of industrial production and public utilities and industrial advisor for Gen Douglas A. MacArthur. The former executive vice-president and general manager of the American Rolling Mill Co is now at work in Japan.

JUSTIN R. WHITING, president of Consumers Power Co, addresses a regional meeting of stockholders at Jackson, Mich. This was one of four such meetings held for the first time this year. Others were at Grand Rapids, Flint, and Saginaw. Of 27,617 stockholders, 17,000 live in Michigan. Smallest meeting was in Saginaw on Good Friday evening, where 125 were present, largest at Grand Rapids, 600

St. Lawrence Project Bogs Down in Congress

The St. Lawrence Seaway, like much of the rest of the Truman program, has bogged down in Congress—for this year at least. And there is some suspicion that the Administration can thank itself for that result.

Last January the President called for authorization this year of the vast power and navigation development. He and members of his Cabinet have made frequent subsequent pleas for the project. But it was not until two weeks ago that Senate majority leader Scott Lucas introduced a so-called "Administration bill" to authorize the seaway.

The Lucas Bill, which was sponsored by eight other Democratic and 11 Republican Senators, would approve, with some amendment, a 1941 agreement between Canada and U. S. for joint construction of the project. It would require "reasonable" tolls on shipping using the navigation facilities to be constructed. It provides also that electrical energy produced be distributed by the State of New York.

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Analogue Machine Course

Designed particularly to meet the needs of users of industrial types of computing machines, a special course in analogue computation will be given at Massachusetts Institute of Technology, June 30 through July 9. The course will deal especially with the treatment of engineering problems by machines designed for the solution of differential equations. Information on registration can be secured from Dr Samuel H. Caldwell, professor of electrical engineering, at the Institute in Cambridge, Mass.

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Decatur, Ind., Drops Plan to Expand Power Plant

Decatur, Ind., has dropped plans to improve its municipal power plant because of financing difficulties. An order for a turbine placed with the General Electric Co in 1946 has been cancelled. The city will pay GE $15,000 for negotiating the sale of the turbine to Wyandotte, Mich.

Since June, 1942, when a unit at the plant went out of service, the city has been buying extra power from the Indiana & Michigan Electric Co. The municipal plant has been producing about 85% of the system's needs.

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Buggs Isle Strike Ends

A ten-day strike of over 500 members of AFL crafts unions at Buggs-Island Dam ended June 10 when union leaders ordered the men back. Demands of the strikers had included union recognition, higher wages, and improved working conditions. No settlement was reached, and union leaders would give no reason for ending the strike. The strikers were employed by the contracting firm building the dam for the Army Engineers.

Sale of Idaho Power Co Planned by Oregon Co-op

Sale of the Malheur Electric Co-op Association of Vale, Ore., to the Idaho Power Co has been approved by the co-op's board of directors and is now subject to ratification by the membership.

The sale was recommended because of high operating losses suffered by the co-op. As a result of an accumulated loss of more than $100,000, the co-op is in default to the government by some $60,000 in principal and matured interest. Unless it increased the cost of service, Pres Harry B. Wilcoxon said, the co-op would continue to lose about $1,000 a month.

Idaho Power's offer provides for payment of $473,000 for all facilities of the association, for assumption of obligation for consumer deposits, and for return to association members of all membership fees advanced by them. The co-op serves a wide rural area in Malheur County, Ore., and Fayette County, Idaho.

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Purchase Offer Rejected

Gulf States Utilities Co's offer to city officials of Lafayette, La., to purchase the power system for $3.1 million has been unanimously declined. The finance committee of the citizens' planning group had previously rejected the offer. Gulf States now serves a large number of customers in the Lafayette area, and its power lines skirt the city.

SEC RULINGS

New England Electric System (Boston) has received authorization to conduct stabilization purchases of the stocks of Boston Edison Co, Lynn Gas & Electric Co, and Western Massachusetts Companies, during the bidding period for the sale of its stock holdings in such companies. As previously reported, NEES proposes to solicit offer for the purchase of its holdings of 123,100, 15,175, and 8,607 shares of the respective companies. It would acquire in stabilization purchases not more than 10,000 shares of the Boston Edison stock on the Boston Stock Exchange and in the over-the-counter market, and nor more than 1,200 shares and 2,000 shares, of Lynn and Western, respectively, in the over-the-counter market. (Release No. 9067).

Niagara Hudson Power Corp's application for a six months' extention from May 1, 1949, within which it must dispose of its interest in Buffalo Niagara Electric Corp in accordance with a plan for reorganization and consolidation of Buffalo, Niagara & Eastern Power Corp and certain of its subsidiaries approved by SEC in 1945, has been granted. (Release No. 9075).

Standard Gas & Electric Co's request for adjournment of hearings on its plan for simplification of the capital structure of the Philadelphia Co, Pittsburgh subsidiary of Standard Gas, has been granted. The commission has postponed the hearings from May 24 to June 27. (Release No. 9083).

American Light & Traction Co has been authorized to change its name to American Natural Gas Co (a name more descriptive of the business in which the system is engaged), and to amend its certificate of incorporation in several respects. Charter amendments would reduce the par value of the company's 4,000,000 authorized common stock from $25 per share to the same number of shares without par value, alter the provisions relating to preemptive rights of stockholders, and reduce the amount of authorized 6% non-callable $25 par value preferred stock to 30,554 shares, the number of said shares now outstanding. (Release No. 9084).

Narragansett Electric Co. Providence, R. I., has been authorized to issue and sell from time to time prior to Aug 1, 1949, up to $950,000 of promissory notes to meet a May 23 maturity on $400,000 of outstanding short-term notes, to provide new money for construction expenditures, and to reimburse its treasury for prior expenditures. The company, a subsidiary of New England Electric System, previously applied for authorization to increase its short-term bank borrowings by $3,750,000, the amount of proposed borrowings being reduced to $2,350,000 by amendment filed Apr 27. It then requested permission to borrow the $950,000 to tide it over the period of time which may be expected to elapse prior to the commission's determination of the issues with respect to the balance of the borrowings and its show-cause order directed against the system and certain of its subsidiaries which raises the question whether the commission should rescind or modify prior orders permitting a maximum of $28,170,000 of borrowings by the subsidiaries in view of altered plans for equity financing by the system. Hearings with respect to these issues are still in progress. (Release No. 9094).

Staten Island (N. Y.) Edison Corp has been authorized to effect a recapitalization and to offer for sale at competitive bidding $2,750,000 of 30-year first mortgage bonds and 40,000 shares of preferred stock ($100 par). Of the proceeds of the bond sale, $1,500,000 will be used to retire a like amount of outstanding bank notes, the balance to be utilized for construction purposes. Under its proposed recapitalization, General Public Utilities Corp, parent, will surrender to Edison for cancellation all of the latter's outstanding preferred and common stock (2,725 shares of voting preferred, no par, and 260,000 shares of non-voting common, no par). In return therefor, GPU is to receive $4,000,000 of the proceeds of the sale of Edison's 40,000 shares of preferred stock, to be sold after the issuance and sale of its bonds, together with 325,000 shares of Edison's new common stock ($20 par). Under an SEC order of Aug 13, 1942, GPU must divest itself of its interests in Edison. Recapitalization of Edison is considered a prerequisite thereto and will facilitate such disposition. (Release No. 9104).

Public Service Co of Oklahoma has received authorization to issue and sell, at competitive bidding, 50,000 shares of a new series of preferred stock, cumulative, $100 par. Proceeds of the sale of stock will be used to finance, in part, the company's construction program through the year 1951, aggregating $23,285,000. (Release No. 9108).

United Gas Corp's proposal of certain amendments to its charter and by-laws has been permitted to become effective. In approving the plan of reorganization of its parent, Electric Power & Light Corp, the commission reserved jurisdiction over the slate of eight nominees for election to the board of directors of United in order to assure the termination of interlocking relationships between United and the new company organized under the plan, Middle South Utilities, Inc. (Release No. 9101).

Public Service Co of New Hampshire has received authorization to issue and sell 104,804 additional shares of common stock ($10 par). The commission denied the company's request for exemption of the sale from its competitive bidding rule. Proceeds will be applied to the company's construction program and other corporate purposes, including repayment of short-term bank borrowings incurred for the interim financing of construction expenditures. (Release No. 9102).

Texas Power & Light Co has received authorization to issue and sell to its parent, Texas Utilities Co (both of Dallas), an additional 2,500,000 shares of the former's no par value common stock for a cash consideration of $3,000,000 to be applied to Texas Power's construction program. Texas Utilities owns all of the 2,600,000 out-standing shares of Texas Power stock. (Release No. 9111).

Oklahoma Gas & Electric Co has received authorization to issue and sell $10,000,000 of 30-year first mortgage bonds, subject to the results of competitive bidding. Proceeds would be used to finance in part the company's $16,000,000 construction program for 1949 and to repay $3,500,000 of short-term bank loans. (Release No. 9113).

MEETINGS

American Institute of Electrical Engineers
Summer General Meeting, New Ocean House, Swampscott, Mass., June 20-24; Pacific General Meeting, Fairmont Hotel, San Francisco, Calif., August 23-26.

Public Utilities Advertising Association
Annual Meeting, Netherland Plaza Hotel, Cincinnati, Ohio, June 20-21.

American Society for Engineering Education
Annual Convention, Rensselaer Polytechnic Institute, Troy, N. Y., June 20-24.

Edison Electric Institute
Hydraulic Power Committee, Shirley Savoy Hotel, Denver, Colo., June 22-25.

Northwest Electric Light & Power Association
Accounting & Business Practice Section, Vancouver Hotel, Vancouver, B. C., June 23-24.

American Society for Testing Materials
Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 27-July 1.

* **American Society of Mechanical Engineers**
Semi-Annual Meeting, University of California Extension Building, San Francisco, Calif., June 27-July 1.

Canadian Electric Association
Annual Meeting, Banff Springs Hotel, Banff, Alberta, Canada, June 28-30.

* **NYS Assn. of Elec. Contractors & Dealers, Inc.**
Golden Anniversary Convention, Saranac Inn, N. Y., July 2-9.

* **Maryland Utilities Association**
Fall Conference, Cavalier Hotel, Virginia Beach, Va., September 9-10.

* **Rocky Mountain Electrical League**
Fall Convention, Stanley Hotel, Estes Park, Colo., September 11-14.

* **Instrument Society of America**
Clinic on Maintenance of Industrial Instruments, Statler Hotel, St. Louis, Mo., September 9-12; Annual Convention, Municipal Auditorium, St. Louis, September 12-16.

* **Illuminating Engineering Society**
National Technical Conference, French Lick Springs Hotel, French Lick, Ind., September 19-23.

* **Pennsylvania Electric Association**
Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., September 20-21.

* **National Electronics Conference**
Edgewater Beach Hotel, Chicago, Ill., September 26-28.

* **National Television and Electrical Living Show**
Second Annual Show, Sponsored by Chicago Electric Association, Chicago Coliseum, September 30-October 9.

* Additions this week.

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Utilities Plan Merger

Merger of South Jersey Power & Light Co, Minotola, into the facilities of Atlantic City Electric Co is planned by the two utilities. The action would terminate an existing contract under which South Jersey purchases all its power from the Atlantic City company. Through application of the latter's rates, merger would result in an annual saving of about $25,000, or 8%, to South Jersey's customers.

February Energy Sales Advanced 6.2% Over '48

Sales of electric energy to ultimate customers in February, 1949, totaled 21,142,721,000 kwhr, the Edison Electric Institute reports. This was a 6.2% increase over the 19,903,528,000 kwhr sold in February, 1948.

Revenues from ultimate customers amounted to $389,526,800 in February,

Classification of Sales, February

Kilowatthour Sales February	Million Kwhr 1949	1948	Percent Change
Residential or domestic	5,269	4,633	+13 7
Rural (Distinct rural rates)	456	429	+ 6 3
Commercial or industrial			
Small light and power	3,835	3,518	+ 9 0
Large light and power	10,220	9,897	+ 3 3
Street & highway lighting	233	219	+ 6 5
Other public authorities	550	534	+ 3 0
Railways and railroads			
Street & interurban	321	387	—17 1
Electrified steam railroads	211	226	— 6 7
Interdepartmental	48	59	—19 7
Total to ultimate customers	21,143	19,904	+ 6 2

compared with $357,942,100 in February, 1948, an increase of 8.8%.

For the 12 months ended Feb 28, 1949, the average use per customer advanced to 1,586 kwhr from 1,465 kwhr for the preceding year, an increase of 8.3%; the average annual bill to $47.42 from $44.83, an increase of 5.8%; revenue per kwhr dropped to 2.99¢ from 3.06¢, a decrease of 2.3%.

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Utility Revenues Advanced 7.7% in First Quarter

Electric operating revenues of the larger privately owned electric utilities in the United States for the first quarter in 1949 were $1,112,764,000, compared to first quarter 1948 revenues of $1,033,033,000, an increase of 7.7%.

Revenue deductions (including operating expenses, depreciation, and taxes) were $885,374,000, up 6.7% from $830,015,000 reported for the first quarter in 1948.

Electric operating revenues for March amounted to $362,165,000, compared to $340,347,000 in March, 1948. Revenue deductions for the month were $291,309,000, up 5.4% from last year. Gross income increased 12.2% to $88,906,000 and net income 13.1% to $67,217,000, FPC reports.

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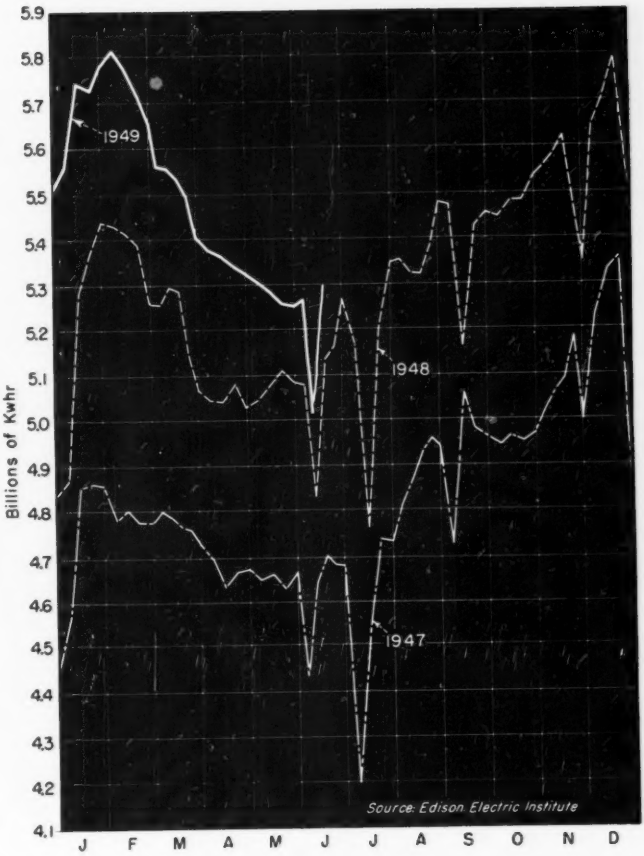
Plant Sale Held Illegal

Sale by the town of Dorval, Quebec, of its power plant to the Quebec Hydro Commission has been set aside by the Superior Court because of a flaw in procedure.



Output Percent Change Narrows Again

Recovering from the precipitous drop recorded for the week containing the Memorial Day week-end, June 4, the output curve swung sharply upward during the following week. The amount of electrical energy distributed by the light and power companies of the country during the week ended June 11 totaled 5,300,091,000 kwhr, according to figures released by the Edison Electric Institute.

During the corresponding week last year the total amount of energy distributed amounted to 5,131,811,000 kwhr, this year's figure representing an increase of 3.3%. The percentage increase has been narrowing during the past few weeks, from 3.8% for the week ended May 28 to 3.6% for the week ended June 4 and to 3.3% for the week ended June 11.

The Central Industrial States, which entered the minus column during the week ended June 4, remained there during the succeeding week, with a decrease of 1.1%, as compared with 0.5%. The New England and Mid-Atlantic groups also remained in the minus column.

Weekly Output, Millions Kwhr

1949	1948	1947
June 11 5,300	June 12 5,132	June 14 4,702
June 4 5,018	June 5 4,845	June 7 4,635
May 28 5,270	May 29 5,076	May 31 4,429
May 21 5,255	May 22 5,085	May 24 4,663
May 14 5,257	May 15 5,109	May 17 4,616
May 7 5,284	May 8 5,087	May 10 4,653
Apr 30 5,304	May 1 5,042	May 3 4,640
Apr 23 5,376	Apr 24 5,027	Apr 26 4,668
Apr 16 5,343	Apr 17 5,087	Apr 19 4,660
Apr 9 5,360	Apr 10 5,033	Apr 12 4,620
Apr 2 5,378	Apr 3 5,037	Apr 5 4,693
Mar 26 5,404	Mar 27 5,065	Mar 29 4,729

Percent Change from Previous Year

	June 11	June 4	May 28
New England	— 6.0	— 3.2	— 2.9
Mid-Atlantic	— 3.6	— 4.1	— 1.4
Central Industrial	— 2.4	— 0.5	+ 1.5
West Central	+ 4.5	+ 6.1	+ 6.8
Southeast	+ 3.6	+ 5.8	+ 3.6
South Central	+ 8.6	+16.1	+12.4
Rocky Mountain	+ 10.5	+ 8.4	+11.9
Pacific Coast	+20.7	+14.3	+11.0
Total United States	+ 3.3	+ 3.6	+ 3.8

WASHINGTON COMMENT

WILLIAM B. WHICHARD

OUTSTANDING candidate for most resilient political figure of this or any other year is Federal Power Commissioner Leland Olds, recently announced as President Truman's choice for his third five-year term on FPC.

Originally named to the Commission in 1939, when he was comparatively unknown, Olds rapidly became one of the most influential, certainly the most controversial, figures ever to sit on FPC. He twice has been chairman of that quasi-judicial body, despite his vehement and often-announced distaste for one of the two industries over which FPC holds critical authority. Now, assuming his confirmation by the Senate, he is a better than even bet to head the Commission again, but soon.

During his tenure as a Commissioner, Olds has been "wrong" politically more often than any other official who comes quickly to mind. During the war, for example, he sponsored several FPC surveys concluding that the U. S. definitely would be unable to produce sufficient electric energy to support its gigantic industrial expansion. He attempted to wrest from WPB's Office of War Utilities its authority to tell the electric utilities what new equipment they could have and when. By 1946, when he was again serving as chairman, he had become so involved in long-standing feuds with key members of Congress that FPC had to fight annually for the appropriations needed to keep it in business. As head of the agency, Olds had to speak for the Commission before Congress.

At any rate, after the Republican victory in the November, 1946, Congressional election, Olds gave up FPC's chairmanship, effective Dec 31, 1946. He was succeeded by soft-spoken Nelson Lee Smith, and FPC's relations with Congress improved notably—for a time.

FPC obtained its annual appropriation the following spring in just about the amount it really hoped for. On the other hand, Congressional moves to revise drastically both the basic statutes administered by FPC, the Federal Power Act and the Natural Gas Act, got under way and rapidly gained momentum. Though a schism already was developing on the Commission over the vacancy created by the retirement of Richard Sachse in early 1947, the four members presented a united front against both of the proposed amendatory bills.

This union was doomed to short life. When the Gas Act revisions developed as the most serious proposal, three Commissioners, including Olds, offered a counter-proposal. They adopted a formal FPC rule renouncing federal jurisdiction over certain phases of the Natural Gas industry. This seemed to meet one of the principal demands of proponents of the Gas Act amendments.

Olds' subsequent change of mind on the formal rule—he soon decided that FPC did so have, and should have, the powers it had renounced—is historic. The 1948 Presidential campaign, during which Olds in speech after speech urged Truman to espouse the public power issue, also has passed into history. Today Olds apparently has recouped completely his political stature. According to sources close to the White House, he is regarded as well nigh indispensable as a member of FPC because of his reputation for "protecting the public against the utility interests."

With complete control of FPC now safely in his grasp, Olds need find the answer to only one other question: Who is going to protect the utility industries from Leland Olds? It's doubtful whether he will lose much sleep over that one.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Condensate is lacking when a new plant is started up. In some cases it is made especially, in others brought in in tanks.

Instruments at high level on control boards can hardly be read by the operator while he is stooping low to make corresponding adjustments located at the bottom.

Nomeclature for automatic control needs to be standardized. What, if any, is the important difference between proportional, throttling, droop, gradient and first derivative?

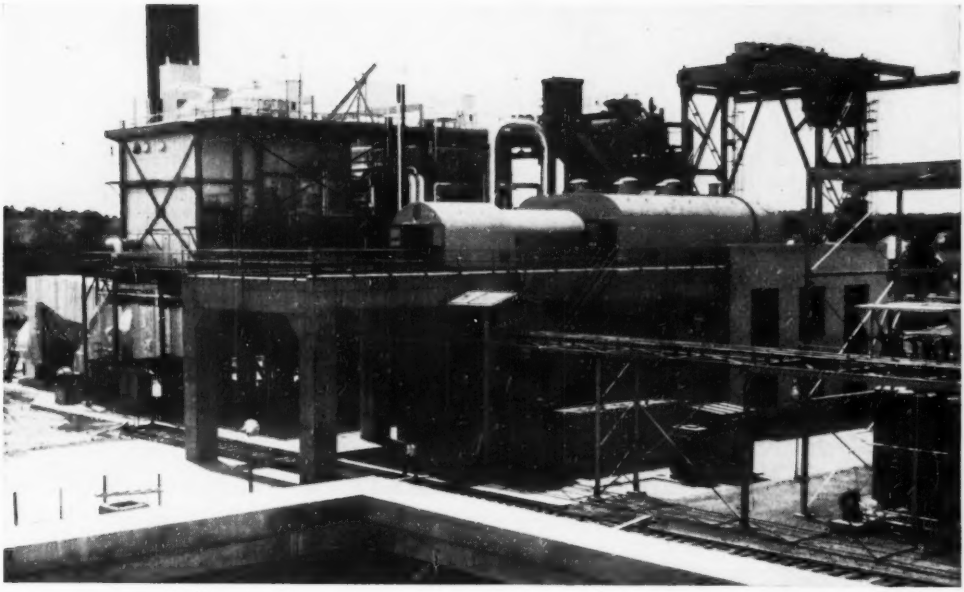
Pole-top air-break switches have to be well and durably alined. Linemen have almost had to be millwrights to do the job properly.

Totally enclosed auxiliary motors in one plant mishap had only the paint damaged when slag leaked from the boiler and completely covered them.

Solar heat at the equator is about 5,000 hp per acre at noon. Egypt derived 63 hp per acre from 1,442 pounds of steam per hour at 15.3 psi from five 205-ft boilers placed in the axial focus of longitudinal parabolic mirrors of 13,000 sq-ft area.

Loss-of-field protection becomes more pressing when increase of system capacitor kva raises the power factor near unity, incurring the risk of instability if a generator should be deprived of excitation.

Powering to the extent of about 228,000 hp is indicated for the 103-mile two-way belt conveyor proposed for taking coal northward from the Ohio to the Great Lakes and iron ore in the reverse direction.



OUTDOOR STATION of Texas Electric Service Co at New Handley has boiler units, generator, condenser and various auxiliaries in the open. Sectional housing over turbine-generator is removable. Generator leads, right foreground, go directly to main three-phase step-up transformers, at right. Note auxiliary supply transformer and 2300-v metal-clad switchgear below generator bus

Handley Design Paces Outdoor Trend

Single-unit outdoor station near Ft. Worth incorporates latest advances in simplification of steam stations. Minimum housing provided. Surface condenser in open. Electrical design follows unit system

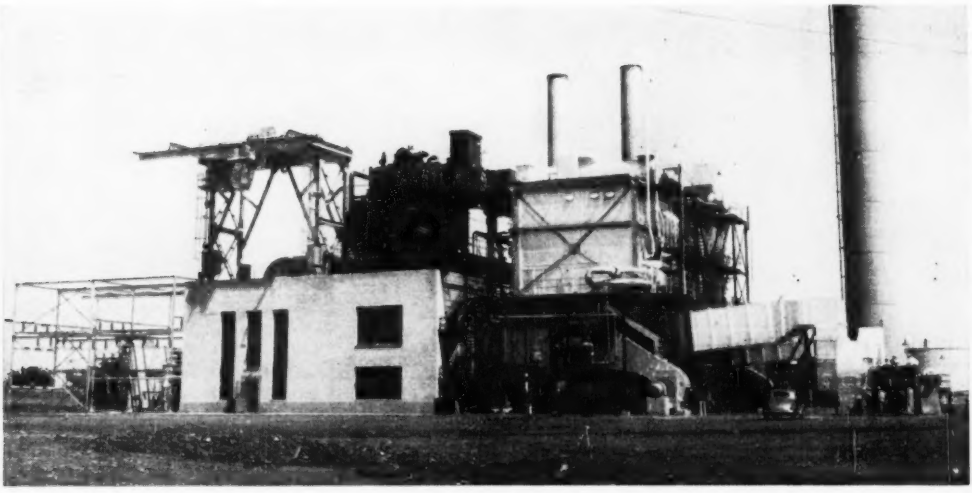
W. F. FRIEND
Ebasco Services, Inc, New York
and
C. A. LILLY
Superintendent of Power
Texas Electric Service Co, Ft. Worth, Texas

ALTHOUGH NOT RADICAL, the type of outdoor generating station design typified by New Handley Station, the 43,750-kw single-unit plant of the Texas Electric Service Co in Ft. Worth, clearly represents the most progressive step to date in the simplification of steam stations.

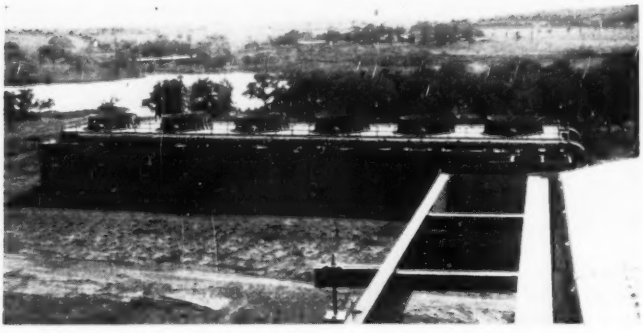
At New Handley not merely the boilers but also the generator, condenser, fans and various other auxiliaries are in the open. The station "building" measures only 40 ft by 60 ft. It accommodates at mezzanine level the central control room that houses the main electrical switchboard as well as boiler and turbine gage boards. Boiler feed and other auxiliary pumps, toilet and miscellaneous facilities are below at finished yard grade, atop the foundation mat. Canopy-type weather protection is provided for the boiler firing aisle, while the turbine has a separate-removable housing that slides along rails flush with the operating deck, to expose the unit for inspection and maintenance.

By these and other coordinated simplifications of equipment and piping, a saving approaching $10 per kw was achieved—as against the cost of a conventional fully-housed plant. Field construction of the plant was expedited by such simplification. The actual reduction in overall time required for the project is hard to estimate, because of difficulties in obtaining delivery of equipment.

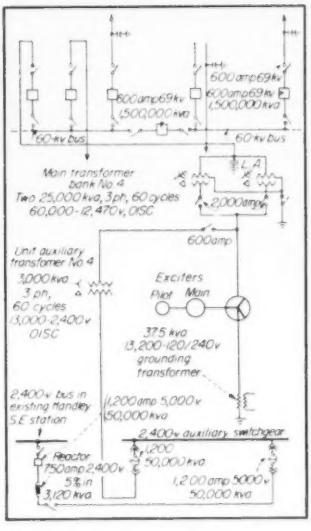
Although weather in Fort Worth can be rigorous when a Texas "norther" blows down in winter, the first year's operation of New Handley has proved the practiability of this advanced type of outdoor generating station in a climate zone where temperatures as low as —8 F have been recorded. The value commonly used



FRONT OF STATION—Gantry for turbo-generator, and deaerator are above roof over control room. Forced draft fans are below boiler



COOLING TOWER for New Handley Station is a 6-cell induced-draft rated 82.6 cfs; provides an independent condensing water system. Second cooling tower will be added later



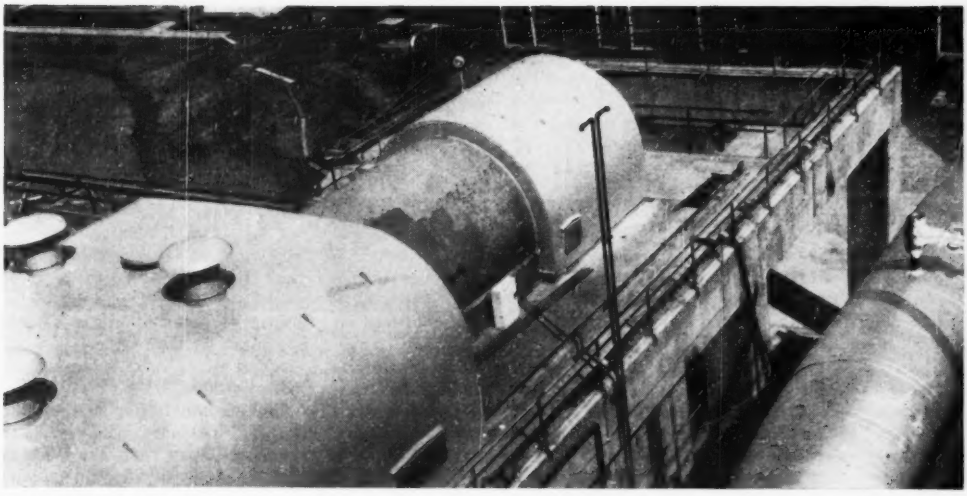
ELECTRICAL CONNECTIONS at New Handley Station follow the unit system with generator leads going directly to the two main 25,000-kva 3-ph transformers. Auxiliary power is taken directly from generator leads; starting power from old Handley station

for the design of heating systems is 10 F. A normal heating season has a 2355 deg-day deficiency (with 65 F as reference).

Provision has been made at New Handley for sudden temperature drops, protracted periods of below-freezing weather, occasional extreme low temperatures and high wind during cold weather and for sleet storms. Principal hazards—freezing of pipe lines and small equipment—are being met by a variety of precautions such as enclosure in compact jackets, use of insulation containing embedded steam or electric "tracer" lines, the grouping of small pipes and instrument connections as well as by maintaining some minimum flow by using bypasses, drilled check-valve discs and drains. Regulators and relief valves, where vulnerable in exposed locations, have been fitted with housings warmed by resistance elements or lamp bulbs.

Plans for Extension

Using the experience acquired at New Handley and contemporary outdoor projects, plans are now proceeding for an extension to this plant involving a 60–75 Mw unit to be completed late in 1950. Steam conditions will be identical with the original installation (1850 psi 900 F) but a single boiler will be used. This extension will go beyond New Handley in minimizing structures and equipment. For example, it is contemplated that turbine exhaust will be taken horizontally into twin condensers on either side of the unit, reducing by about 15 ft the height of the turbine operating deck above the main floor at yard level.



TURBINE HOUSING (left) is carried on rails flush with operating deck. It can be pushed back over the generator and exciter when maintenance and inspection are necessary. Movement is accomplished by using the crane. Weatherproof housing over exciter is provided

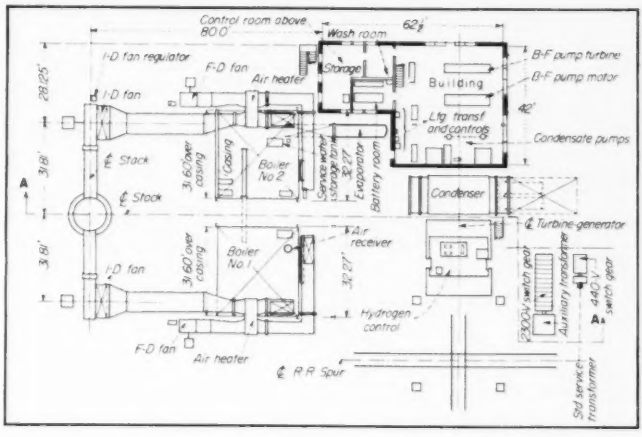
Texas Electric Service Co with its neighboring companies, Dallas Power & Light Co and Texas Power & Light Co, constitutes the North Texas Interconnected System. Together they serve about 500,000, or about one-quarter, of the customers in the state. Peak loads in 1948 for the three companies aggregated 665 Mw and for the interconnected system was about 640 Mw after allowing for diversity. Of this 21% was within the Fort Worth area where the New Handley station was installed.

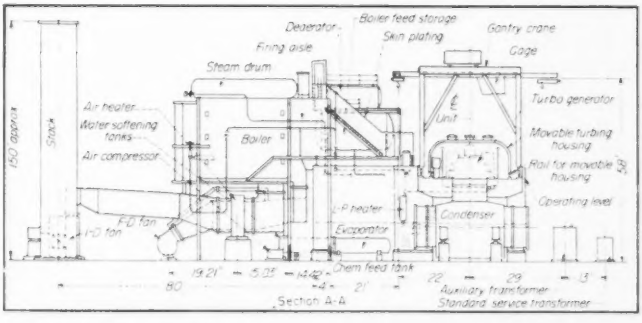
Planning For New Handley

In the early planning for New Handley Station, choice of the site, six miles from downtown Ft. Worth, was determined largely by: (1) Location and adequacy of existing transmission facilities, (2) plans for establishing a high-voltage ring to embrace the city, (3) availability of natural gas fuel, water supply, highway and rail facilities and (4) land.

The 91-acre site included the 16,-000-kva 200-psi Handley steam plant originally developed in 1909 to supply an electric railway system. For this reason, transmission lines were available in the vicinity capable of carrying output of the new plant.

Also on the site was 20-acre Lake Erie, originally used not only as condensing water supply for the old station but also as the main attraction





MINIMUM ENCLOSURE characterizes arrangement of New Handley Station facilities. Turbine boiler and electrical controls are housed in the small plant building at mezzanine level above the floor containing auxiliary pump, lighting controls and miscellaneous facilities

of a recreation park. Subsequent additions to the 40-year-old station have required augmented cooling capacity. This was obtained by installing a spray system over part of the lake.

When New Handley Station was built, the capacity of Lake Erie was fully utilized by the older plant. It was necessary to install a 6-cell induced draft-type cooling tower rated 82.6 cfs to provide an independent condensing water system. With the addition of the proposed 60–75 Mw unit in 1950, a second cooling tower will be provided in line with and adjacent to the first.

Low Fuel Cost

Selection of a 35,000/43,750-kw unit for the New Handley project was predicated on an economic analysis covering a number of alternate programs for system capacity additions, with account taken of generating stations, transmission facilities and interconnections.

Steam conditions of 850 psi, 900 F at throttle with extraction at four points for feedwater heating were determined in large degree by the price of natural gas fuel available for power generation in Ft. Worth and vicinity at roughly 80.10 per million Btu. Although the East Texas oil field is relatively near, present price of oil restricts it to use only as standby fuel. In 1948 it constituted less than 1% of total fuel consumption at New Handley. Coal and lignite are possibilities for the indefinite future, if and when the price of natural gas rises to a level making the changeover to solid fuel an economical practice.

A simple regenerative cycle without reheat, and boilers showing an average efficiency of 82% were adopted as suitable for the fuel cost. Under special conditions prevailing at the time, two boilers, each rated 215,000 lb per hr, were selected in preference to a single large unit because of a more favorable price and delivery schedule. Simplification of engineering also resulted from the duplication of boilers purchased a short time previously for a station elsewhere. For the second New Handley unit, however, a single steam generator has been adopted.

In its first 12 months of operation, ending April 29, 1949, New Handley outdoor unit has turned out 363,354 Mwh or 42,828 kw average hourly net station output. Performance is close to 12,100 Btu per net kwhr. It is expected that this will be bettered when exhaust pressure is lowered by improvement of cooling tower performance, and when throttle steam temperature is raised to design value.

Electrical connections at New Handley follow the "unit system". As indicated in the one-line diagram, main generator leads go directly to main 3-ph step-up transformers. There are two of these, each rated 25,000 kva 60–12.5 kv with fans for raising capacity to 30,000 kva. Auxiliary power supply is derived from a 3,000 kva 13–2.4 kv auxiliary transformer connected to main generator leads through disconnecting switches. Standby and starting service for auxiliaries is supplied through a 2-4-kv feeder from the old Handley station.

The high-voltage side of the main transformer bank is connected to a 60-kv switchyard bus through an overhead line about 1,100 ft long. Four 60-kv lines are supplied from this bus, two have phase-comparison carrier current relaying, one has carrier-current three zone distance impedance relaying, and the other has three-zone impedance relaying.

All buried metallic structures at New Handley, such as circulating water pipes, supply water lines, conduits, and grounding system are safeguarded against external corrosion by cathodic protection, using a 50 amp 12-v selenimum rectifier. The installation is one of the first of this type to be applied to a generating station.

Need for cathodic protection was indicated by severe corrosion of both cast iron and steel yard piping experienced at the original Handley station site nearby. Soil resistivity tests confirmed the corrosive nature of the soil. Coatings were not considered entirely dependable for the local conditions prevailing. With the entire pipe system electrically interconnected with copper ground bus and ground rods, it was recommended that a ground bed and rectifier be installed since the current requirement for cathodic protection would be of the order of 50 amp. Galvanic anodes would have been less economical, in view of the low-cost of electric power for the rectifier.

Two Heat Pumps

Two electric heat pump installations are included. One regularly serves the control room and is a conventional type with 5-hp motor and uses either cooling tower or well water as heat source. The second installation is a 7.5-hp experimental unit arranged to take heat from condenser discharge water and alternatively from outdoor air. It is intended to obtain comparative performance data with operation on the two heat sources, and to develop simple and economical methods for defrosting the pickup coil under climatic conditions at Ft. Worth.

A new operating force was recruited to staff the New Handley installation, which is the first outdoor type station on the Texas Electric Service Co system. The staff was drawn largely from men *without* previous steam station operating experience. Some of the men initially trained here were later transferred after a few months to another new station, also of the outdoor type at Permian Basin in West Texas.

In general the regular operating staff has readily accommodated itself to the conditions. There were, as usual, a number of short emergency outages while starting and testing. First scheduled outage for inspection and maintenance was in May 1949, allowing ten days for turbine unit and one week per boiler, and using maintenance personnel drawn largely from other stations of the company.

Ebasco Services Incorporated has rendered engineering and construction services to Texas Electric Service Co on this project and is now preparing designs for the 60/75 Mw second unit.

Vital Statistics

New Handley Generating Station

Ratings

Turbo-generator, nameplate rating, kw	35,000
Turbo-generator, capability, kw	43,750
Boilers, number	2
Boilers, rating, lb per kw	215,000
Throttle pressure and temperature	850 psi, 900F
Cooling tower rating	82.6 cfs
Cooling water range F	105 to 90

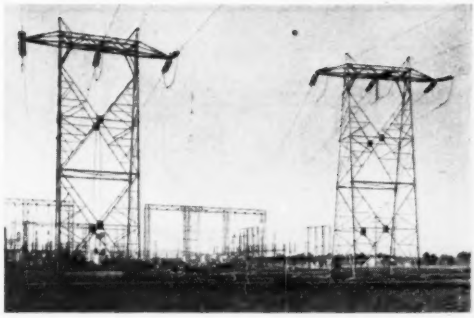
Station Output Data (First 12 months)

Total gross generation (in kwhr)	381,848,000
Total net generation (in kwhr)	363,354,000
Maximum 1 hr peak (kw)	50,000
Hours operation	8,484

Station Performance (First 12 months)

Billions Btu used	4,391,733
Station heat rate—net—Btu per kwhr	12,090
Station load factor, %	99.7
Station availability, %	97.2

STANDARD 230-kv suspension tower of Metropolitan Water District of Southern California. Line was built originally without lightning protection; two overhead ground wires added after four years of operation in which interruptions averaged 27 per year



STANDARD 220-kv suspension tower of Southern California Edison Co. Lightning protection is provided by two overhead ground wires and radial counterpoises where needed. Service interruptions due to lightning have occurred on the average of 1.2 outages per year

How Much Protection From "Lightning Protection?"

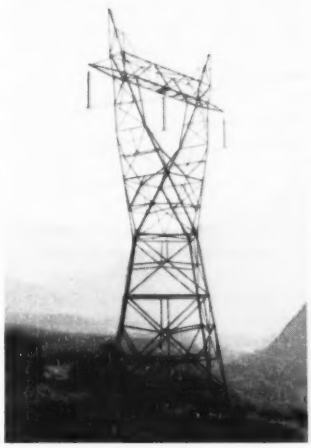
Performance records of parallel high voltage lines demonstrate clearly effectiveness of three degrees of lightning protection—no ground, overhead ground, radial and continuous counterpoise

OPERATING RECORDS of high voltage transmission lines from Hoover power plant to Los Angeles afford a unique opportunity to compare performance of comparable lines under a wide degree of lighting protection. Six lines of 220, 230 and 287.5 kv traverse the same general route, and have nearly identical exposure to an isoceraunic level of about 15. Operating records with no lightning protection; two ground wires and some radial counterpoises; and two ground wires with continuous counterpoise wires are presented in the three accompanying articles.

Lightning Experience With No Ground Protection

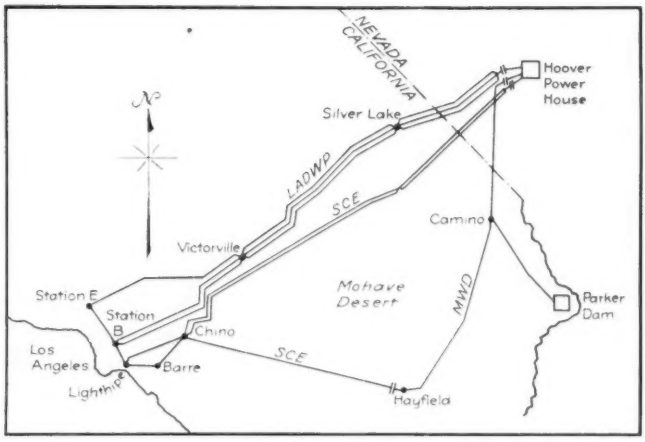
E. W. ROCKWELL
Senior Electrical Engineer
Metropolitan Water District of So. Calif.

The Metropolitan Water District of Southern California has built and now operates a 230-kv line for transmission of electric power from Hoover Dam to the District's pumping plants in southern California. The line was designed solely for transmission of power for a water pumping system having storage reservoirs of sufficient capacity to permit interruptions in electric service greatly in excess of interruptions ordinarily experienced by most power systems. The line consists of conventional rectangular base structural steel towers supporting conductors of 795,000-cm ACSR in flat configuration, with provision for two ½-in. steel overhead ground wires on brackets extending upward from the tower bridge. Initially, overhead ground wires were omitted except for sections of the line adjacent to stations. Conductors are supported by 13 conventional porcelain suspension units (5¾ × 10 in.).



SINGLE CIRCUIT 287.5-kv suspension tower of Los Angeles Department of Water and Power. Two overhead ground wires, two continuous counterpoise wires are used for lightning protection. Three flashovers in 12½ years operation have been attributed to lightning but actual proof is lacking

The line was placed in operation in Nov 1938. Service interruptions from lightning during the first 4 years with no overhead ground wires averaged 27 per year. These inter-



Line Characteristics

	MWD	SCE	LADWP
Av. Length, mi	237	233	263.5
Kilovolts	230	220	287.5
Av. Span, ft	1,320	1,400	1000—Single cct. 850—Double cct.
Insulation-units	13 $5^{3}/_{4}$x10 in.	15 10 in.	24 5x10 in.
Conductor, Mcm	795 ACSR	605 Alum.	512—HH copper
Ground Wire	$2^{1}/_{2}$ in. high strength galv. steel		$2^{1}/_{2}$ in. Copperweld on double cct.
Ground Wire Spacing from Conductor, ft.	36	25	40

MWD—Metropolitan Water District of Southern California SCE—Southern California Edison Co.
LADWP—Los Angeles Department of Water and Power

ruptions did not have any serious effect upon line and equipment or on pumping the required amount of water. Aside from the nuisance of having to place the system back in service after each interruption, operation was considered entirely satisfactory.

Continuous Load Added

During the recent war, there was built near Hoover dam a magnesium plant which received power from the same generators that supplied energy for the district system. The magnesium plant required a continuous supply of power free from the interruptions and voltage fluctuations which might be caused by outages on the district system. As a remedy to this situation, overhead ground wires were installed on the district line. Interruptions in service due to lightning were reduced to the extent that but three have occurred during the last six years.

Initial cost of the district's 230-kv transmission line was about $10,000 per mile. Installation of overhead ground wires added about $1,300 per mile. Service for the district alone did not justify the additional cost of overhead ground wires, but their installation has eliminated a nuisance factor in operation of the system. The line as now operated not only supplies power to the district's pumping plants but also transmits Hoover dam energy to the Southern California Edison Co system at Hayfield pumping plant and to the Bureau of Reclamation installations at Parker dam.

System outages due to lightning have been experienced as follows:

Year	No. of outages
1939	37
1940	22
1941	26
1942	33
Ground Wires In Service	
1943	1
1944	0
1945	1
1946	0
1947	0
1948	1

Lightning Experience With Overhead Ground Wires

CORT LOWERISON
Protection Engineer
Southern California Edison Co

The original line between Hoover powerhouse and the Southern California Edison Co system was placed in operation May 12, 1939. This line was built for operation at 220 kv between Hoover and Chino substation, a distance of 233 miles. On Sept 20, 1949 an additional line section between Chino and Barre was placed in service. Two transformer banks deliver 150,000 kva of Hoover power from these lines into the system.

System load and generating resources in 1939 were considerably different from those that prevail today. Hoover powerhouse was used mainly as a kwhr plant as reliable peak capacity was available elsewhere on the system. Early in the planning for this line it was thought that no overhead ground wires would be used, but as it became more apparent that this line should be built to give as reliable service as consistently possible it was agreed that two should be used. Specifications provided that at dead end towers the ground wires should be midway between and at least 8 ft above the conductors and at suspension towers they should be midway between and at least 12 ft above the conductors. In mid-span they should be at least 25 ft in actual distance from the conductors. With these vertical separations at the towers it was necessary to use $\frac{1}{2}$-in. extra high strength steel for the ground wire in order to get the required separation in mid-span.

Tower Footing Resistance

During the period of Aug 30, 1937 to Jan 1, 1938, tower footing to ground measurements were made at 258 tower locations on the line for the purpose of determining if and where means should be provided for lowering the resistance. The line was originally designed for operation of ground fault neutralizers and studies indicated that if flashovers due to lightning were to be prevented, the resistance to ground should be limited to 66 ohms, and that if flashovers were to involve not more than one phase to ground, tower footing resistance to ground

of not more than 100 ohms could be permitted. Tests were made with a "Megger" ground resistance tester. Out of a total of 880 towers in the line, it is believed that 258 locations tested probably include all locations where high resistance is likely to be encountered.

From these measurements and additional geographical considerations, 54 tower locations were selected to be equipped with counterpoises to lower the footing resistance. There were only 28 whose resistance to ground exceeded 100 ohms, the additional 26 being chosen from consideration of geographical factors such as location, character of soil, etc. and also from the fact that some towers whose resistances were expected to be high could not be measured when the tests were made.

Results of Testing

All 54 towers were equipped with two radial counterpoises, each consisting of four 200-ft lengths of ½-in. galvanized steel cable, buried and tamped in a trench from 1½ to 2½-ft deep. Results obtained are shown in the following summary of a report prepared soon after the installation was completed:

1. Resistances of 258 tower footings were determined with values ranging from 0.3 ohms to greater than 300 ohms.

2. Fifty-four towers having resistances near or greater than 100 ohms were lowered to an average for the group of 9.3 ohms.

3. No towers in the group of 258 tested had a resistance to ground exceeding 70 ohms after counterpoises were installed where needed.

4. Variations in moisture content of the soil around tower footings alter the resistance by as high as 17 times, with an average in 21 cases of about three times.

The line was operated with ground fault neutralizers in service from May 1939 to November 1941. During this time there were 10 cases of trouble: four due to lightning, four from brush fires, and two from station equipment failures.

On Aug 10, 1941 a section of line between Barre and Lighthipe was placed in service. This tied the Hoover 220-kv line into the main 220-kv transmission system; however, the ground fault neutralizers remained automatic at Hoover, Chino and Barre until Nov 15, 1941 when the second Hoover-Chino 220-kv line was placed in service.

Causes of Line Troubles

Year	Station Equipment Failure	Lightning	Brush Fires	Aircraft	Fog and Defective Insulators	Unknown	Total
1939	2	0	0	0	0	0	2
1940	0	4	4	0	0	0	8
1941	0	0	0	0	0	0	0
1942	0	1	0	0	0	0	1
1943	0	1	0	1	0	0	2
1944	0	0	0	1	1	1	3
1945	0	2	0	2	0	0	4
1946	0	2	0	0	0	0	2
1947	0	1	3	0	4	0	8
1948	0	1	0	0	1	0	2
Totals	2	12	7	4	6	1	32

After completion of the second Hoover-Chino line and a line section between Chino and Laguna Bell, the Hoover 220-kv lines have been operated with solidly grounded 220-kv neutral connections except at Hoover powerhouse where a 33-ohm resistor is in series with the neutral.

A complete summary of line troubles since 1939 is shown in the table above.

A comparison of lightning troubles of the ground-wire protected lines of the Southern California Edison Co with another line from Hoover dam not protected with ground wires indicates a decided advantage for ground wires as a means of protection against lightning. Our record shows a frequency of 0.25 flashovers per year per 100 miles of line.

Lightning Experience With Continuous Counterpoise

C. P. GARMAN
Chief Electrical Engineer and Deputy General Manager
Los Angeles Department of Water and Power

The two original transmission lines of the City of Los Angeles 287.5-kv system are of twin-circuit construction for 225 miles, and of double circuit construction for the remaining 11 miles into receiving station "B" in Los Angeles. They run in a southwesterly direction from Hoover dam to Los Angeles, and they were put into operation in Oct 1936. Construction of a third single-circuit line was completed in 1940. This circuit follows the same route from Hoover dam taken by the original single-circuit sections for 130 miles, at which point it branches off to the west to terminate at receiving station "E", which is also in Los Angeles.

The isoceraunic level of the country traversed varies from about 30 at Hoover dam to 5 around Los Angeles. The average is about 15.

These lines were designed for high reliability, and all the 287.5-kv towers carry 2 overhead ground wires and 2 continuous copper counterpoise wires. Tower footing resistances measured from 1.0 to 150 ohms before installation of counterpoise, and measured from 0.4 to 10.0 ohms after counterpoise installation, with an average of 0.8 ohms. The two intermediate switching stations at Silver Lake and Victorville sectionalize each circuit into three approximately equal lengths.

Because of the fact that the copper counterpoise is connected to the steel tower legs through $\frac{1}{16}$-in. air gaps, it is possible to obtain indication of lightning strokes to the towers or connected overhead ground wires. Impulse currents larger than 4,000 amp leave beads of burned metal on the surface of the brass counterpoise gaps. It can, therefore, be determined that the circuits have been struck by lightning over 2,000 times, without flashover of the lines.

While the records show that in the 12½ years of operation three flashovers are attributed to lightning, actual proof that lightning was the cause is lacking. Overhead ground wires and towers and conductors have been carefully examined in each instance and no positive indication of the lightning stroke terminating on the equipment has been found. The lack of any other apparent cause for flashover in these three instances has been a major factor in attributing the cause to lightning. In any event, the operation of the lines cannot be regarded as anything short of "highly satisfactory."

POINTS ASSIGNED TO FACTORS AND KEY TO GRADES

FACTORS	DEGREES AND POINTS							
	1st	2nd	3rd	4th	5th	6th	7th	8th
1. Education	20	40	60	80	100	120		
2. Experience	25	50	75	100	125	150	175	200
3. Complexity of Duties	20	40	60	80	100			
4. Monetary Responsibility	5	10	20	40	60			
5. Contacts	5	10	20	40	60			
6. Working Conditions	5	10	15	20	25			
Add for Supervisory Jobs Only								
7. Type of Supervision	5	10	20	40	60			
8. Extent of Supervision	5	10	20	40	60			

POINT RANGE	GRADE
Up to 120	A
125-160	B
165-200	C
205-240	D
245-280	E
285-320	F
325-360	G
365-400	H
405-440	J
445-480	K
485-520	L
525-560	M

NEMA'S Salaried Job Rating Plan is based on these factors, grades and points. Backed by sufficient data which is known to be sound, these tools will arrange your salaried jobs into one constructive pattern. You can apply this plan as high in the company as you choose

Rate Salaried Jobs, Too, For Good Employee Relations

NEMA develops a companion piece to its Hourly Rated Job Rating plan. Utility management can apply it readily to large groups of workers

EXTENSION of job rating into the salaried-job area is one of the most constructive steps open to a company interested in sound employee relations. And no longer is this process an esoteric one.

Latest contribution to the field is a Salaried Job Rating Plan devised, after several years of research, study and testing, by the National Electrical Manufacturers Association. To acquaint its membership with the salaried job rating plan, NEMA is proposing a series of area training institutes which will be held this year and next. The institutes will be limited to participation by representatives of member companies. Attendance will be held to approximately 35 trainees. If interest develops on the part of electric utilities or other non-members, representatives of such companies may be given the opportunity to attend. Meanwhile, though, copies of the NEMA plan, and the Manual of Procedure explaining how it should be put to use, are available to non-members.

The plan was developed by NEMA's Industrial Relations Committee through a Technical Subcommittee on Job Rating. A. L. Kress, a management and industrial relations consultant and formerly manager of NEMA's Industrial Relations Department, prepared the Manual which accompanies the plan, and assisted the subcommittee.

Sound salary administration is based on well-defined policies and procedures—not on a mass review or on awaiting pay increase requests. These policies include assurance that salary levels and other benefits compare favorably with those for comparable jobs in the area; establishment and maintenance of fair salary differentials within and between jobs which are based solely upon differences in job requirements; annual audit of job descriptions and duties; and promotion from within the organization.

Application of the NEMA plan rests on three steps, each of which contributes to the following step.

First, information must be obtained as to job duties and a job description carefully written.

Second, jobs must be rated under the rating plan.

Third, a salary schedule must be developed.

Key to the entire procedure, of course, is the writing of job descriptions. It's the most difficult part of the job, too, and will require half or more of the time devoted to applying the plan. This information may be

JOB RATING SPECIFICATION

SALARIED JOB RATING PLAN

Occ. No. 2004
Division: Sales
Dept. or Plant Promotion
Grade K

Job Name: SALES ENGINEER Class

Job Description

Under general supervision of Sales Manager, act as sales and service representative in the field for (insert product). Contact technical representatives of customers and discuss their problems and requirements; correlate requests of customers with manufacturing possibilities. Assist in development of products; make suggestions and recommendations from knowledge obtained from field trips for manufacturing procedures and inspection limits. Obtain information regarding competitors' products, quality, prices. Review trade literature. Visit customers' or prospective customers' plants; interview representatives; observe products in use; investigate complaints; obtain first hand information as to operating requirements; prepare reports of visits. Correspond with customers, prospective customers as to prices, products, applications. Keep customers sold on Company products, services and development work. Keep superior informed as to problems, difficulties, status of work.

Promote From: To:

Analyst	Dept. Head	Revised	Revised	Revised
Initials				
Date				

This job description is not a complete statement of all the duties and responsibilities which go with the job. It contains only the facts necessary to rate the job fairly.

JOB RATING SPECIFICATION

SALARIED JOB RATING PLAN

Occ. No. 2004
Division: Sales
Dept. or Plant Promotion
Grade K
Points 400

Job Name: SALES ENGINEER Class

FACTOR	SPECIFICATION	RATING Deg.	RATING Pts.
EDUCATION	Use mathematics through trigonometry. Work from drawings specifications. Deal with problems of product application, use, efficiency, recommending applications. Requires knowledge of an advanced type in field of mechanical engineering customarily acquired by four years college.	5	100
EXPERIENCE	Over 4, up to 6 years	4	100
COMPLEXITY OF DUTIES	Plan and perform difficult work where only general methods are available because require discretion, independent action and judgment to resolve facts as to practice applications, evaluate situations and state or recommend action.	4	80
MONETARY RESPONSIBILITY	Considerable monetary responsibility when advising and assisting in price preparation of estimates, quotations, and handling important customer accounts.	3	60
RESPONSIBILITY FOR CONTACTS WITH OTHERS	Repeated contacts with customers and prospective customers to influence them to purchase and continue to use Company products, requiring a high degree of salesmanship.	3	60
WORKING CONDITIONS	Somewhat disagreeable due to large amount of traveling involved.	2	10
	FACTORS TO BE ADDED FOR SUPERVISORY JOBS ONLY		
TYPE OF SUPERVISION			
EXTENT OF SUPERVISION			

YOU CAN'T complete a job rating properly without the data—in permanent record form, too. Here's NEMA's suggested form. One side bears the job description, plus record space. The other lists factors governing the job, and the record of the rating assigned it

obtained from the employee—either in writing or through an interview—or from his supervisor. Jobs just can't be rated from their titles. There must be descriptive, inclusive statements of job duties and responsibilities. The description itself is a simple, concise statement of what it is an employee is called upon to do regularly. It needn't be detailed, although it must be founded upon detailed knowledge. It is necessary so that employees may be classified after jobs have been rated.

Job descriptions take two forms—the chronological and the functional types. The latter is the more common, and fits best those jobs whose duties are varied. The former, also called the "cycle" type of job description, is suited best to jobs where the employee performs repeatedly a set pattern of work.

Let Employees See Them

Approval of finished job descriptions is recommended. Approval by immediate supervisors and departmental heads probably will be mandatory. But it's believed that it would be smart to get the jobholder's approval too. And plainly, when new jobs are created or duties are reassigned, those existing descriptions which are affected need review.

Having completed job descriptions, it is possible to start rating the jobs under the NEMA plan. The plan itself uses a point system similar to that employed by NEMA's well-known Hourly-Rated Plan.

There are six factors against which non-supervisory jobs are assessed. Two more have been added for supervisory jobs. These factors, and the degrees (or stages) to which the rating for each may be carried, are:

1. Education.
2. Experience.
3. Complexity of duties.
4. Monetary responsibility.
5. Contacts.
6. Working conditions.

For supervisory jobs, these factors are added:

7. Type of supervision.
8. Extent of supervision.

The point totals which derive from the application of these factors are grouped in twelve grades on a scale from A through M. These grades, of course, are the key to the third and final step in the plan—the development of a salary rate schedule.

To perform the actual rating of each job, certain facts must be in hand about each rating factor as it applies to each job. These can be obtained when an employee specifies his duties, simply by asking him, for instance, how much education and experience he believes his job requires, what its contact requirements are, and its monetary responsibilities. Or this information may be obtained from the department head at the time each job is rated.

Rating the Jobs

With the information in hand, the person performing the job rating program, helped by the department head concerned, actually rates the jobs. ALL JOBS SHOULD BE RATED ON ONE FACTOR AT ONE TIME—to simplify the process and to maintain consistency. When all jobs have been so rated on all factors, the grade for each may be determined by the point totals. The problem then will be one of thorough review, both by the department head and by management.

Invaluable in both the job description and the actual rating will be a Job Specification Sheet. On it may be formalized the data which contribute to the job description, the relative evaluation of factors and the point

EXHIBIT G

SALARY SCHEDULE — MONTHLY RATES

20% X 12½%

Grade	Minimum	Rate Range Midpoint	Maximum	Range
A	$135	$148	$160	$25
B	150	165	180	30
C	165	185	205	40
D	190	210	230	40
E	215	240	265	50
F	245	270*	300	55
G	275	305	335	60
H	310	340**	375	65
I	350	385	420	70
K	390	430	470	80
L	440	485	530	90
M	500	550	600	100

* Midpoint actually $272.50

** Midpoint actually 342.50

Note: This schedule is constructed to give a 20% range within each Grade (levelled to the nearest $5) with a 12½% differential between midpoints.

EXHIBIT H

LEARNER PROGRESSION SCHEDULE

Grade	Hiring Min. Rate	3 mos.	6 mos.	9 mos.	12 mos.	15 mos.	18 mos.	24 mos.	30 mos.	Range
A	$125	$135								$10
B	130	140	$150							20
C	135	145	155	$165						30
D	155	165	175	190						35
E	175	185	195	205	$215					40
F	195	205	215	225	235	$245				50
G	215	225	235	245	255	265	$275			60
H	240	250	260	270	280	290	300	$310		70
J	270	280	290	300	310	320	330	340	$350	80
K	310	320	330	340	350	360	370	380	390	80
L	360	370	380	390	400	410	420	430	440	80
M	420	430	440	450	460	470	480	490	500	80

Note: The above Learner Progression Schedule is to be applied to Inexperienced Employees. In the case of Grades A to C, it would apply to persons with little or no previous work experience, such as high school graduates. Beyond those Grades, the minimum hiring rate has been graduated on the basis that persons for such jobs would have had work experience though not necessarily in the field for which they were hired. Beyond Grades F or G, the Schedule is primarily for promotion purposes. The Schedule should be regarded as a *minimum* progression schedule. Supervision should advance employees *more rapidly* if they make exceptional progress.

A SALARY SCHEDULE, such as the sample shown above, is what you should turn up with after careful preparation. Because no job classification for beginners ever should be set up, NEMA's Plan includes a sample progression table for learners, shown in the next column

totals. Such a sheet also will furnish the permanent record of HOW and WHY a given job was rated as it was. It can best be a two-sided sheet, bearing the job description on one side, and the specifications on the other.

At this point, the company using the NEMA plan will find itself with its jobs graded. The number of different grades it will use will depend on the caliber of the jobs it has rated and the height, in the organizational structure, to which the company chooses to extend the plan. The number of grades will be determined after evaluation. It should not be predetermined, with an attempt made to fit the rated jobs into an arbitrary number of grades.

Developments of Schedule

Now starts the development of a salary schedule. Such schedules will rest on: Prevailing area rates for comparable jobs; the company's existing salary structure; and the principles of a sound salary structure.

These principles are not to be had from any formula. Among the factors which should be considered are the percentage from lowest to highest WITHIN a grade; the percentage differentials BETWEEN grades; and the period through which the salary schedule may be anticipated to be effective. The spread between lowest and highest within a grade will depend, of course, upon policy regarding merit increases. The percentage between grades may refer to the step between the minimum for one grade and that for the next, or from midpoint—even between grade maximums. The choice rests upon the type of salary structure which is sought.

Frequency and amount of merit increases also will enter the construction of a salary schedule. Obviously, company policy will govern in this matter. The suggestion is made that mass reviews not be made, since they may preclude careful consideration of every employe, and since they may induce a feeling that such raises may be taken for granted.

Where it is impossible to obtain the data necessary for a sound salary survey, a schedule may be constructed in this fashion:

Develop a schedule of rates for stenographers. This should include neither beginners rates nor those of secretaries. Establish a rate range for the job of 20 or 25% (covering increases within grade). This should be based upon the middle 50% of those employees surveyed. With this one job on a salary schedule, construct a schedule for all Grade C jobs (Grade C is where stenographers should rate under the NEMA plan.) Then compute the midpoint for Grade C. From this, midpoints for other grades may be computed by adding whatever percentage differential may be considered proper. These increments should be levelled off to the nearest $5 if the schedule is constructed on a monthly basis.

How much will it cost to adjust existing salaries to those suggested by a sound salary schedule?

That will depend upon the relation between the company's salary structure and the area's structure, and on the cost to eliminate intra-company inequities. The point is made, though, that it may not necessarily be sufficient to bring employes who are below the minimums prescribed by the new salary schedule merely up to those minimums. They should be raised to that salary level called for by their abilities and service.

As for putting the plan into effect, a company will have some policy decisions to make. Should individuals be told their job title, grade and range? Should individuals be permitted to question their grade? Should they be permitted to see the specification sheets for their own jobs? NEMA suggests that the best answer is "yes."

Operation Suggestions

When putting the plan into operation, it is suggested that a letter explaining it—signed by the chief executive—be sent all employes: that each employee be notified in writing of his job title, grade and rate range; that employes receiving salaries above the maximum rate range at which their jobs are classified be assured that their salaries will not be reduced while they hold the jobs; that employes be assured they may discuss their grade rating; that an administrative policy statement be prepared for guiding those who must operate the program; and that the ratings be audited each year.

PREFABRICATED UNIT PANELS of aluminum make up this 8 by 12-ft temporary control house designed by Bonneville Power Administration

Unit Construction For Temporary Control Houses

KEITH KRUCHEK
Mechanical Engineer
ARTHUR WETSCH
Chief, General Shop Unit
Bonneville Power Administration
Portland, Oregon

PANELIZED, demountable buildings of aluminum alloy have cut costs and solved transporting, prefabricating and storing problems for temporary control houses. Such houses are an important factor in serving economically areas of rapidly expanding load, during initial growth.

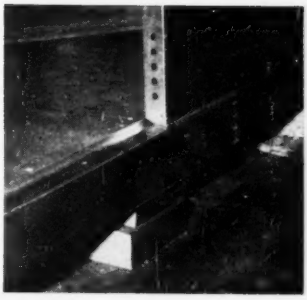
Engineering and Shop Units of the Bonneville Power Administration solved the problem by designing and constructing of aluminum alloy the type of building shown. It is of unit construction and assembled in multiples of the basic 4-ft panel unit. Aluminum was chosen because of its light weight for handling and transporting, ease of fabrication in forming and welding, and low maintenance costs. It is also inherently resistant to corrosion and needs no surface treatment when proper alloys are selected, keeping maintenance to a minimum.

The panel type construction is readily adaptable to assembly line production, giving a further reduction in cost. Assembly is entirely by bolts and screws with all exterior joints coated with alumilastic caulking compound before assembly.

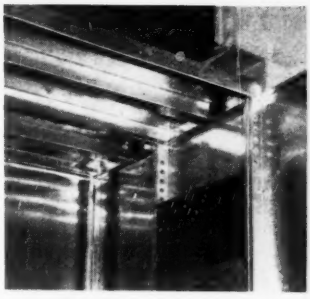
Simplified Erection

Erection is simple. Floor panels are assembled on the foundation blocks, flashing is laid and wall sections bolted in place. Roof sections, gutter and trim are installed, and after electrical wiring is completed the prefinished interior wall panels are fastened in place. Interior walls, ceiling and floor are then given 2 coats of clear shellac. The exterior is left mill finish aluminum.

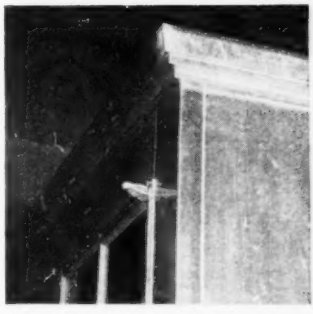
To date Bonneville has built and is using 9 temporary houses of this type, with 14 more scheduled for the near future.



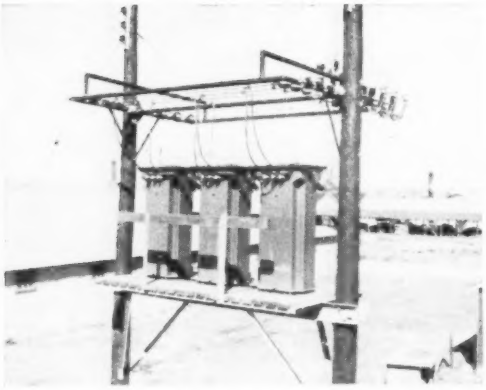
FLOOR SECTIONS are ¾-in. waterproof plywood fastened to a frame of 5-in. aluminum channels and I-beams spaced on 16-in. centers. One floor section in each house provides wireway and floor thimbles for bringing in yard wiring



EXTERIOR WALLS are 2 by 8-ft sections of 0.081-in. aluminum with flanged edges to form vertical studding. Edges are punched with ¾-in. holes to provide for electrical wiring with armored cable. Roof sections are 2 ft wide with integrally formed edge stiffeners and a formed stiffener joined to panel center with rivets



FLASHING AND GUTTERS have corner sections mitred and welded, with erection joints on the side. Hinge mounts door of hollow slab type construction, reinforced with aluminum stiffeners. Paneling around doors and windows utilizes waste material



FLAT BUS of primary and secondary wires with all accessories

ONE-POLE rack made of 2-in. pipe for three 50-kva transformers

Shop-Built Package Units Speed Service To New Loads

To meet special conditions, pole-mounted 3-phase distribution transformer banks, capacitor assemblies, branch regulator equipments, and primary metering units were shop fabricated to save time and money

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Gulf States Utilities Co
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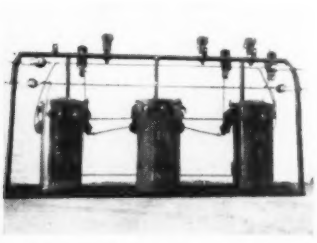
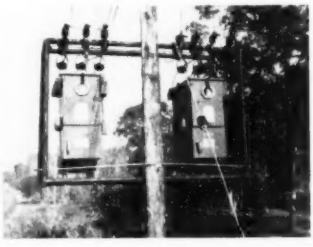
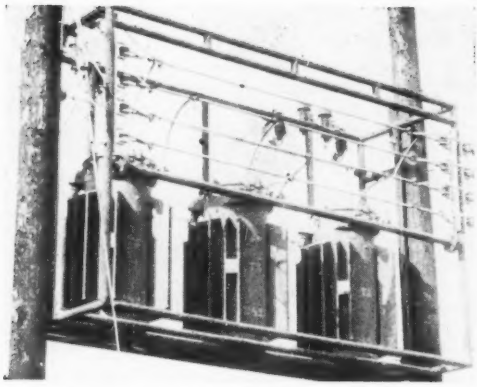
USE of experimental package units grew directly out of the necessity of installing hundreds of transformers and capacitors each month to serve the greatly expanded demands of old and new customers. The units are designed so they can be built completely wired in the shop in a few hours by two men, delivered to the line crews as a package, hauled to the job, hoisted up the pole, and connected in an hour or so; rather than laborious piecemeal assembly of various types of units 25 or 40 ft above the ground. Both time and money are saved, since experienced workers are limited and line crews cost $100-$150 a day.

A conventional single pole three-phase transformer bank installation consists of as many as 125 separate pieces. A conventional two pole transformer bank installation may consist of as many as 450 separate pieces. Certainly our industry should give careful thought to the practice of hoisting 450 separate pieces 40 ft in the air and putting them together piece by piece, when such work can be done in the shop with power tools and the mechanics can

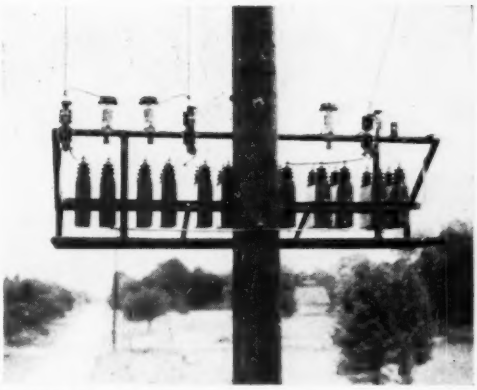




SMALL PIPE RACK mountings (left to right): 15-kva transformers; feeder regulators on 2-in. pipe; primary metering unit on 1½-in. pipe



TWO-POLE rack made of 2-in. pipe for three 150-kva transformers



TWELVE 15-kva capacitors mounted on rack made of 1½-in. pipe

move freely around the job. Two men can do the work of assembling in the shop; in the field, the men assembling the units frequently must work near energized conductors some 25 or 40 ft above the ground and usually, three or four men with a truck are at the base of the pole passing equipment up.

The following list of shop built package units have been developed. These units have primary bus, secondary bus, lightning arrestors and fuse cutouts as necessary, all wired and in position before they leave the shop.

1. A flat bus of primary and secondary wires supported by a 2-in. rectangular pipe rack, outside dimensions about 8 x 12 ft. When this rack is mounted above a two-pole platform, it supports all accessories for three 100 or three 150-kva transformers.

2. A 2-in. pipe rack that will support as much as three 50-kva transformers on a single pole.

3. A 2-in. pipe rack for two-pole mounting that will support as much as three 150-kva transformers.

4. A rack built of 1½-in. pipe that will support 12 15-kva capacitors on a single pole.

5. A 1½-in. pipe rack unit for single pole mounting that will support as much as three 15-kva transformers.

6. A 2-in. pipe rack rack that will support two branch feeder regulators with all by-pass equipment on a single pole.

7. A rack of 1½-in. pipe that will support a complete 2,300 or 4,160-v primary meter outfit, that is, cutouts, lightning arrestors, instrument transformers along with secondary terminal box.

These package units eliminate a great deal of field work that would otherwise be done by men trained to climb. Package units can also be shop assembled by men who are not trained to climb. The company does not regard the units as standard. Their application is special, but where appearance and speed are important, these shop fabricated units may have a place.

Survey Shows Preference For 4-In. Conduit, 1½-In. Spacing

A SURVEY of duct spacing used with various sizes of conduit in the underground systems of 60 typical electric utilities shows a strong preference for 4-in. conduit using a 1½-in. duct spacing. There is an indication, however, that some of the larger utilities are displaying some interest in 5-in. conduit.

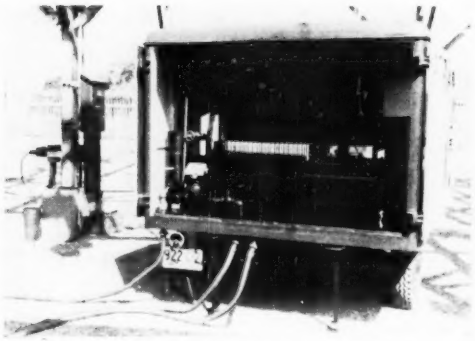
Results of the survey, which was conducted by the Line Material Co and reported by W. R. Schwarte at the 1949 Engineering Conference of the Missouri Valley Electric Association, are given in the accompanying tabulation.

Of the 60 companies contacted 28 indicated that they were using a 1½-in. vertical and horizontal duct spacing. This is by far the preferred spacing; however, the remaining 32 companies indicated a wide variance of spacings.

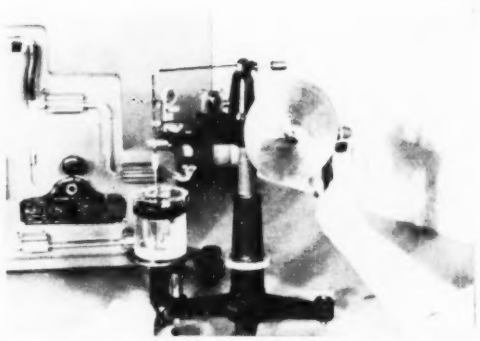
Four companies indicated no use of spacers whatsoever. All the remaining companies indicated that they formed for themselves some type of precast spacers. Practically all companies were interested in purchasing a precast spacer. This indicated a strong trend toward using the built-up system of conduit construction. This construction utilizes the forming of a solid framework of conduits and spacers surrounded by a 3-in. concrete envelope.

Duct Spacing Practice of 60 Utilities

Conduit Size, In.	No. Companies	Duct Spacing, In.				
		1	1½	1¾	2	3
4	14		x			
4	11	x				
4½	6				x	
3	6		x			
4	3				x	
3 & 4	3		x			
2, 3, 4 & 4½	3		x		x	
4	2		No spacers used			
2, 3, 4	2				x	
2, 3, 4 & 4½	2					x
4½	1		x			
4½	1		No spacers used			
3	1	x				
2, 3, 4	1		x			
2, 3, 4 & 4½	1			x		
4 & 4½	1				x	x
5	1		No spacers used			
5	1	x				x
	60					



TRAILER EQUIPPED for reconditioning circuit breaker oil



INTERFACIAL TENSION test apparatus measures oxidation

Appraising the Serviceability Of Power Transformer Oils

Determination of whether to replace the oil or recondition it and the transformers rests on interpretation of sufficient testing to establish the condition

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Mechanical Engineering Division
American Gas & Electric Service Corp
New York

IN THE EXAMINATION of used oils on the American Gas & Electric System only those tests which establish the ability of the oil to withstand continued service are made. An interpretation of these test values shows whether no attention, reconditioning, reclamation, or replacement is advisable. Tests are made for viscosity, specific gravity, neutralization value, color, interfacial tension, steam emulsion number, power factor, dielectric strength, free water, and sludge content. If the results of these tests indicate the need, additional tests are made for saponification number, resin content, asphalt content, carbon, composition of sludge, dissolved moisture, and ash content.

The tests outlined in an accompanying panel are important when evaluating an oil but no single test can be used for this purpose. The interpretation of the individual test results must be based on their combined significance. How this is accomplished may be shown more clearly by conclusions reached concerning samples of used transformer oil from the field, the analyses of which are shown in the accompanying table.

Analyses of Used Transformer Oils

Item	Sample Number					
	1	2	3	4	5	6
Neutralization Value	0.05	0.25	0.25	0.62	1.2	0.09
Color	8+	8+	3−	5½	3½	1½
Interfacial Tension Dynes/cm 25°	29.8	25.7	16.1	12.0	11.7	19.8
Steam Emulsion Number	1200+	142	163	59	58	174*
Power Factor 20° (%)	2.6	4.17	50.0	0.17	0.25	9.5*
Dielectric Strength (kv)	25	20	7	25	35	29
Soluble Sludge (%)	none	trace	0.02	0.01	0.02	none
Insoluble Sludge (%)	0.3	0.03	0.10	0.04	0.02	none
Composition of Sludge (%)						
Carbon	0.19					
Iron Oxide	0.10	0.06	0.31			
Organic	0.01	0.04		0.05	0.02	
Metallic Soaps		0.02	0.06			
		Iron soap in suspension				
Free Water		trace	0.3		none	none
Other tests		asphaltic material 1.85%	Sap. No. 1.2 mgs.	Sap. No. 1.6 mgs.	Sap. No. 1.8 mgs.	Ash Content 0.11% SiO_2 0.03% Sodium 0.01%

*No change after filtering through paper.
Filtered by suction through 6 x 1 in. bed of Celite.
S.E. No. 70 sec
P.F. 0.92%

Conclusions Based on Used Oil Analyses in Table Opposite

Sample Number 1

The low neutralization value and high interfacial tension indicates that the oil should be relatively free from organic sludge. The high steam emulsion number and power factor indicate the presence of semi-colloidal material.

The analysis of the insoluble sludge shows it to be composed of carbon and ferrous oxide. This material could not be removed by filtering through paper. However, when filtered through Celite, it was readily

Adaptation of paper at recent ASTM symposium on insulating oils.

removed, indicating that the carbon and iron oxide are present in an almost colloidal state. After this filtration the color, steam emulsion number, and power factor were restored to low values and the dielectric was increased to 35 kv.

Confirmed by Examination

From these data it was concluded that the condition of the oil was due to the presence of semi-colloidal material formed by arcing and the burning of iron and oil in the transformer. Subsequent examination of the transformer showed that arcing had occurred.

Since ordinary means of purification could not restore this oil to a condition suitable for service, replacement of the oil was recommended and the oil removed from service was reclaimed. The reclaimed oil now has been in service for six years and is in excellent condition.

Sample Number 2

The neutralization, interfacial tension, and organic sludge content indicate that normal oxidation is taking place. The steam emulsion number does not indicate the presence of semi-colloidal material, but does indicate the presence of a metallic soap.

Since there was no change in the color, power factor, or steam emulsion number after filtering through Celite, it was concluded that bushing compound was present. Subsequent tests showed the presence of 1.35% asphaltic material and examination of the transformer bushings indicated that considerable leaching of compound had taken place.

The sludge present contained ferric oxide indicating rusting in the transformer. The presence of organic iron soap in the sludge suggested corrosion above the normal oil level by formation of iron naphthenate. Examination of the transformer showed the underside of the cover to be rusting and there were patches of iron naphthenate, indicating attack of the iron by oil vapors in the presence of moisture.

It was recommended that the oil be replaced and that the removed oil be reclaimed.

Sample Number 3

The neutralization value and color would indicate that the oxidation of the oil is normal, but the interfacial tension shows the presence of material that is not indicated by the neutralization value.

This is substantiated by the high saponification number. The power factor and dielectric values were restored to normal by filtration through paper, but the steam emulsion number did not change even when filtered through Celite, indi-

Criteria for Oil Condition

Viscosity
In the interpretation of test data the viscosity is used only to identify certain types of oil refined between 1917 and 1920 having viscosities ranging from 46 to 118 sec at 100 F.

Specific Gravity
This value is used only in calculations involving interfacial tension test.

Neutralization Value
This indicates whether oxidation has taken place. It does *not* determine the amount of basic or acidic material present, but shows only the presence of substances in such form that they react immediately with potassium hydroxide at the temperature and time involved in making the test.

Color
The color of an oil is not an infallible sign of oxidation, but the test is of value in revealing that the oil has been overheated or that soluble contaminants such as bushing compounds are present. A rapid change in color of an oil in service indicates trouble, the cause of which should be investigated.

Interfacial Tension
This test is valuable in that it will measure a change in extent of oxidation not detectable by the neutralization value until some time after the change has occurred. Oils having interfacial tension values above 18 dynes usually are free from sludge, but sludge has been reported present in oils having a value as high as 25 dynes. It is possible that analyses in these cases would have shown the sludge to be of an inorganic nature.

Steam Emulsion Number
This value is useful in detecting metallic soaps, bushing compound, sodium silicate, and semi-colloidal material such as the hydrous metallic oxides. It also indicates the ability of the oil to free itself of water. This property is important in transformer oils and still more important in switch oils.

Power Factor
The power factor of an oil increases as the oxidation of the oil progresses. It also is greatly affected by the presence of water and by small quantities of conducting and semi-conducting oil-soluble contaminants such as bushing compound. It is sensitive to colloidal metallic hydrous oxides if present in the oil.

Dielectric Strength
The dielectric strength of an oil is useful in determining the presence of free water. Oils that are sludging badly and have extremely high neutralization values often will show a dielectric strength above 30 kv provided the oil is dry.

Soluble Sludge
The presence of soluble sludge in an oil is a positive indication of deterioration. If the sludge is in suspension in significant amounts, the inorganic content should be determined. Rusting in a transformer often will give the oil an appearance similar to that produced by sludge. The presence of free organic sludge is an indication of progressive oxidation.

Saponification Number
This test measures a portion of the oxidation products present that are not indicated by the neutralization value. While its use for insulating oils is questionable, it is occasionally run as a check on interfacial tension as some correlation exists.

Resin and Asphalt Content
This value of an oil sometimes indicates the presence of varnish or bushing compounds which cause an increase in power factor and steam emulsion number.

Colloidal Carbon
The presence of colloidal carbon indicates the oil has been burned.

Dissolved Moisture
The significance of dissolved moisture and its solubility in oil is not clearly understood, but studies under way may show it to have a bearing on the rate of transfer of moisture from the oil to the transformer solid insulation. Our use of this test generally has been confined to experimental work, but it occasionally is used for the determination of total moisture in bushing oils that have been in contact with activated alumina.

cating the presence of soluble soaps.

The sludge content is high and shows the presence of hydrous ferrous oxide and organic iron soap. It was concluded that corrosion was taking place below the normal oil level causing an emulsion of oil, water, and hydrous oxide to form, resulting in a partial formation of iron soap.

Recommendations were to stop the entry of water to the transformer, and to centrifuge and blotter press the oil until free from the emulsion. The oil then could be considered fit for continued service, but a more rapid than normal rate of oxidation could be expected due to the soap content.

Sample Number 4

The high neutralization value, low interfacial tension, and the presence of soluble and insoluble organic sludge indicates progressive oxidation.

The absence of metallic soaps and semi-colloidal material is shown by the low steam emulsion number and power factor.

As the usual means of conditioning did not change the characteristics of the oil other than to remove sludge, it was recommended that the oil be reclaimed or replaced. The oil eventually was reclaimed and has been in service for the past eight years. It is still in excellent condition.

Sample Number 5

With the very high neutralization number and low interfacial tension value indicated, the oil would be expected to be sludging badly. The low insoluble sludge content and the absence of soluble sludge would indicate one of two things, either the oil had deposited its sludge in the transformer at some time, or only a high acidity had developed.

The small difference between the neutralization value and saponification number indicates that the oil was high in acid. The high dielectric indicates that the transformer was very dry and this might have a bearing on the absence of soluble sludge.

It was concluded that this oil originally had been over refined, resulting in the development of acidity rather than sludge. Recommendations were that the oil be replaced with new oil, but only after the core had been washed thoroughly with reclaimed oil.

Sample Number 6

The very low neutralization number and color would indicate that only slight oxidation had taken place, but the low interfacial tension, high SE number, and high power factor, along with a high dielectric indicated the presence of some type of contaminant.

Filtering the oil through paper did not change any of the determined values, but when filtered through a 6 x 1 in. diam bed of Celite under suction, all values were restored to normal. Analysis of the ash content showed total residue of 0.11% of which 0.08% was silica and 0.01% sodium, the balance being iron and aluminum oxides.

From these data it was concluded that the source of silica was sodium silicate with which the core laminations had been coated.

As the oil was in excellent condition in so far as stability was concerned, the only bad features being the high power factor and steam emulsion number, it was recommended that the oil be kept in service, but that the dielectric be kept high at all times, as oils with this type of contaminant can hold considerable water in suspension. As ordinary means of purification were useless, it was recommended that a special filter for removal of semi-colloidal material be procured for reconditioning this oil and other oils similarly contaminated. Using a laboratory model filter equipped with dense filter packs, the properties of the oil were restored to that found after filtering through Celite. The field results using the special filter are not yet available.

General Conclusions

It is evident from the data shown in the tabulation that some of the tests made are not always significant. For this reason, no fixed set of rules covering interpretation of test results can be used in judging oil condition.

Conclusions must be reached by a careful study of the entire analysis and by consideration of the significance of each test as applied to the individual sample.

Standard Parts Aid Apparatus Development

An Editorial in ELECTRICAL WORLD, *February 13, 1932*

RECENTLY DEVELOPED electrical apparatus utilizes standard parts to a striking degree, in contrast with earlier productions. The use of conventional components in new combinations lowers the cost of development and manufacture, enhances sales appeal and insures better service and lower maintenance costs in commercial operation. This trend is extremely healthy and should be encouraged by users of electrical equipment. Manufacturers who select well-tried elements in making up new material and equipment assemblies may find that the outward appearance of certain products lacks originality, but this weighs lightly with purchasing engineers seeking reliable service no less than efficient performance.

It is better that pride of authorship in designing should be sacrificed to conventional methods where these will serve the purpose. In the long run material is conserved, space saved, safety enhanced, inspection facilitated and manufacturing processes are simplified by this policy. Years ago much new equipment was bulky, misshapen, roughly finished and rather experimental in appearance. Today the most advanced products of recent development resemble lines familiar to the art. These reflect a new manufacturing precision which builds expectation of their success even before they are tested by field service. Switchboard, circuit-breaking, protective and measuring apparatus emphasize this trend to a remarkable extent at the present time.

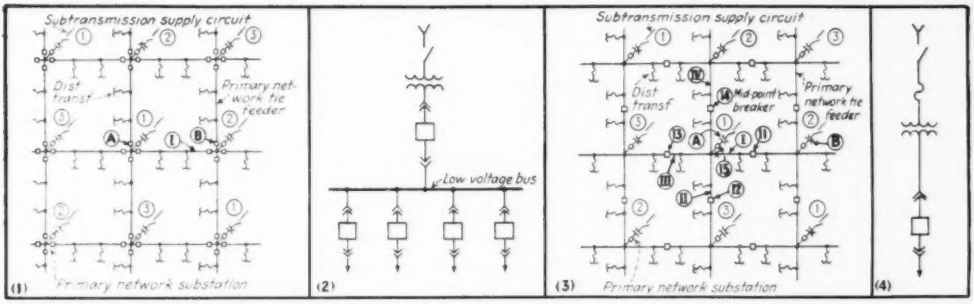

FIG 1—CONVENTIONAL NETWORK system uses breakers on each end of tie feeders and on low-voltage side of substation transformers. Operation of circuit breakers with fault on any feeder discussed under "I—Two Breakers Per Tie Feeder" on this page

FIG 2—SUBSTATION associated with network pattern of Fig 1

FIG 3—SINGLE BREAKER at midpoint of tie feeders reduces number of breakers. System voltage fluctuations are limited during faults but more load is dropped as the result of a feeder fault than with two-breaker scheme of Fig 1. Clearing of fault at X on feeder "I" discussed under "II—One Breaker Per Tie Feeder" on page 83

FIG 4—NETWORK SUBSTATIONS where midpoint breakers are used are simple since tie feeder breakers are eliminated

Primary Network System of Distribution

An evaluation of advantages and limitations of overhead primary network systems. Three fundamental primary network patterns examined. Design data on size and spacing of network substations for various load densities given

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East Pittsburgh

SHOULD distribution systems be radial or primary network? Both systems provide substantially the same quality of service. Choice depends primarily upon installed and operating costs. An examination of the fundamental types of primary networks in use today should assist in making the decision.

In the primary network system it is the primary circuits which are interconnected to form a grid or network as shown in Fig 1. The tie feeders interconnecting the substations supply distribution transformers either directly or over subfeeders and laterals just as do the primary feeders in a radial system. Such a primary network tie feeder is feeder "I" connecting the buses of substations A and B in Fig 1. This feeder may be either open-wire or cable circuit or a combination of the two. Ordinarily the tie feeder will leave the two substations as cable for a short distance and then change to open-wire circuit. Thus the usual tie feeder is essentially an overhead open-wire circuit supplying pole-mounted distribution transformers. The main feeder is a three-phase circuit; however, most of the feeder's length is made up of single-phase subfeeders and laterals which supply single-phase distribution transformers. The main feeder sections and three-phase subfeeders are usually 4,160 v, three-phase, four-wire circuits. The single-phase subfeeders and laterals are 2,400-v single-phase circuits. A few primary network systems have been installed using three-phase, three-wire primary feeders operating at 2,400 v. One company is operating a primary network with 13,200-v primary feeders and 15 kv network equipment has been purchased by one other company.

The pattern of overhead primary network systems today falls into three fundamental groups: I—Those with two breakers per primary tie feeder, one at each end; II—Those with a single breaker per primary tie feeder, usually located at the midpoint; and III—Those in which primary feeder breakers are omitted and tie feeders are connected solidly to form the grid.

Each such system has its advantages and limitations which will be examined in turn.

I—Two Breakers Per Tie Feeder

A fault on any tie feeder of Fig 1 will cause the circuit breakers at its two ends to open due to overcurrent. This completely deenergizes the feeders and interrupts service to all distribution transformers connected to it. In the usual case where the feeder is an open-wire circuit the two feeder breakers are made automatic reclosing. Each breaker is arranged for one or two reclosures before lockout. Their reclosing times are staggered

so that the feeder is reenergized first from one end and then from the other. This gives the affect of two or four reclosures on the tie feeder, half from each end. Since the tie feeder is normally supplied from both ends, occasionally a line burndown will result in a temporary fault on one portion of the feeder and a permanent fault on the other. Thus one feeder breaker will reclose and remain closed to supply a portion of the feeder's load while the other breaker will go through its reclosing cycle and lock out.

Beyond the primary feeders the primary network system is similar in all respects to a radial distribution system. In other words, the distribution transformers, secondaries, and services in a primary network system are the same in rating and arrangement as they would be if the system were radial.

Why Use Tie Feeders?

Since a primary feeder fault results in a service interruption to all loads connected to it, just as in a radial system, the question naturally arises—Why use tie feeders? Tie feeders provide emergency feed to all substations. This permits the use of simple single-transformer substations each of which has only a single subtransmission-circuit supply. In order to have tie feeders function as emergency feeds some of the substations connected into a network by the tie feeders must be supplied over one subtransmission circuit, and other of the substations must be supplied over one or more different subtransmission circuits. The two or more subtransmission circuits which supply a primary network grid must also be interlaced so that adjacent substations are not connected to the same circuit if the tie feeders which form the grid are to be effective as emergency feeds.

The primary network system of Fig 1 consists of a grid of tie feeders and some radial primary feeders to which the distribution transformers are connected. These primary feeders, tie and radial, are supplied over three subtransmission circuits through nine distribution substations. The subtransmission circuits are interlaced so that adjacent transformers are not connected to the same circuit. This is done so that when a subtransmission circuit and its associated substations are out of service the load will be shared more uniformly by the substations and subtransmission circuits remaining in service. This results in a minimum of spare substation and subtransmission circuit capacity in the system, and also improved voltage conditions when a subtransmission circuit is out of service. The subtransmission circuits to which the substantions are connected are indicated by the numbers 1, 2, and 3.

A fault on one of the subtransmission circuits, for example, circuit No. 1, or in one of its associated substation transformers causes the circuit breaker at its supply end to open. Fault current continues to flow, however, over subtransmission circuits No. 2 and 3, through their associated substation transformers, across the tie feeders, and in reverse direction through the substations of subtransmission circuit No. 1 to the fault. This reverse flow of fault current through the transformer breakers of these substations causes the breakers to open and disconnect the faulty subtransmission circuit and its substations from the system. The loads normally supplied by the substations of subtransmission circuit No. 1 are now supplied from the adjacent substations of subtransmission circuits No. 2 and 3 over the network tie feeders. Thus the tie feeders, in addition to supplying their associated distribution transformers, provide an emergency supply to the loads of any substations when their normal power supply fails.

For economic reasons because of the relatively high fault currents which may be encountered in a primary network, system differential relaying is not ordinarily used to clear substation bus faults. Bus faults will be extremely rare in modern metal-clad switchgear. Should such a fault occur, however, it is cleared by means of the overcurrent relays tripping the tie-feeder breakers and by another set of overcurrent relays tripping the transformer breaker. This latter set of overcurrent relays is provided to clear bus faults. These relays are given a longer time setting than the feeder overcurrent relays and are arranged to energize the trip coils of all breakers associated with the substation bus. When they operate they also lock out the reclosing feature of these breakers so that there is no automatic reclosing on a bus fault.

TABLE I—Relation Between Primary Network Substation Ratings and Tie Feeder Sizes

Network Substation Self-Cooled Rating KVA	4160 Volt Network Tie Feeder Capacity KVA	Open-wire Network Tie Feeder Copper Size
1500	1125	2
2000	1500	1/0
2500	1875	2/0
3000	2250	3/0
3750	2810	250Mcm
5000	3750	400Mcm

Effect of Bus Fault

When a bus fault occurs service will be interrupted on any radial primary feeders normally supplied from the bus until repairs are made or service is restored from some emergency feed. Service may also be interrupted on some or all of the primary tie feeders associated with the faulty bus. The interruption of power supply to these tie feeders will be only for a short time, however, as the automatic reclosing of their breakers at the good stations reenergizes them after the breakers on the faulty bus have been tripped and locked out.

Theoretically the type of primary network system shown in Fig 1 provides slightly better service continuity than can a radial system because of the ability to energize most of the primary feeders—that is, the tie feeders—from both ends. This reduces the seriousness of a substation bus fault and sometimes permits automatically restoring service to parts of primary feeders which in a radial system would have to be manually reenergized.

The single line diagram Fig 2 emphasizes the simplicity of the substations used in the system of Fig 1. Each substation consists of a three-phase tap-changing-under-load transformer supplied over a single subtransmission circuit through a disconnecting switch. The transformer is usually throat-connected to

metal-clad switchgear. This switchgear consists of a single bus, a transformer breaker between the bus and the transformer, two or more feeder breakers for connecting the primary feeders to the bus, and the necessary control and protective equipment. Network relays are usually used to trip the transformer breaker when current flows in the reverse direction to a transformer or subtransmission circuit fault. The same relays are used to close the breaker only when voltage conditions on the two sides of the open breaker are such that the transformer will carry load when connected to the substation bus. The transformer breaker is also provided with overcurrent relays to clear bus faults as previously discussed. Each primary feeder breaker is equipped with very inverse-time overcurrent relays and automatic reclosing.

The transformer breaker is always used in a primary network substation to prevent opening up the primary grid when a transformer or subtransmission fault occurs. In spite of its simplicity any part of the substation can be removed from service for maintenance without dropping any load except that on a radial primary feeder. Because a transformer breaker is used the transformer can be easily removed from service for inspection and maintenance of its tap-changing-under-load equipment without any interruption of service.

II—One Breaker Per Tie Feeder

Almost all of the primary network systems in operation today are of the type just discussed and shown in Fig 1. Two other forms of the primary network system have been considered and used to a limited extent. One of these forms uses only one breaker in each tie feeder as shown in Fig 3 instead of the usual two breakers. The tie feeder breakers may be located anywhere in their feeders. It is preferable, however, to locate each of these breakers near the mid-point of its feeder rather than at or near either end of the feeder. The mid-point location results in lower short-circuit duty on the circuit breaker and provides better voltage regulation on these tie feeders, which temporarily become radial when a portion of the primary grid is out of service.

TABLE II—Relation Between Load Density and Primary Network Substation Ratings and Spacings Assuming Uniform Load Density and Spacing Between Substations

Rating of Network Subs KVA	Load Density in KVA per Square Mile				
	½ Mile Between Subs	¾ Mile Between Subs	1 Mile Between Subs	1½ Miles Between Subs	2 Miles Between Subs
1500	6000	2670	1500	668	376
2000	8000	3560	2000	888	500
2500	10000	4440	2500	1112	624
3000	12000	5330	3000	1336	752
3750	15000	6670	3750	1668	936
5000	20000	8880	5000	2224	1248

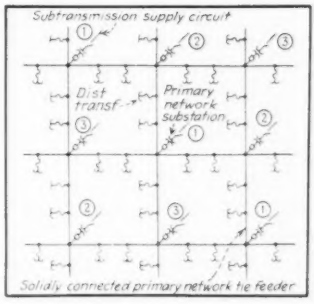


FIG 5—NO TIE BREAKERS are used on this network system. It is assumed that faults will burn clear because of concentration of energy. If fault persists entire grid is dropped until correction is made

In this system (Fig 3) a fault at X on tie feeder "I" connecting substations A and B is cleared by the opening of feeder breakers 11, 12, 13 and 14 and transformer breaker 15, due to overcurrent. The timing of the overcurrent relays is such that the feeder breakers open first and the transformer breaker opens a short time later. Very inverse-time overcurrent relays are usually used with all breakers. It will be noted that the fault at X on feeder "I" interrupts service to half of tie feeders I, II, III, and IV.

The transformer breakers of Fig 3 are equipped with automatic reclosing such as is used on the feeder breakers of Fig 1. Thus if the fault at X is permanent, breaker 15 goes through its cycle of two or three reclosures and locks out. Breakers 11, 12, 13, and 14 remain open until the fault is repaired and breaker 15 is manually closed. These four feeder breakers will then reclose automatically. All feeder breakers in this system are arranged to reclose automatically when substantially normal voltage exists on both sides of them for a predetermined time. The time delay in the reclosing of a feeder breaker must be sufficient to allow a transformer breaker to complete its reclosing cycle before the feeder breaker can reclose. If the fault at point X is temporary, transformer breaker 15 will reclose and remain closed. A short time later feeder breakers 11, 12, 13, and 14 will reclose and restore the grid to normal.

Advantages of this System

The advantages of this primary network system when compared with the system of Fig 1 are: (1) Decreased cost of switchgear, and (2) reduced voltage disturbance when a primary feeder fault occurs. The reduction in switchgear cost is due to the smaller number of feeder breakers used and the lower interrupting duty required. In addition to a saving of one breaker per tie feeder, breakers are usually omitted on the radial primary feeders. Thus the number of feeder breakers has been reduced from 36 to 12. The reduction in voltage disturbance is due to the fact that during the reclosing cycle of a transformer breaker its associated primary feeder sections are disconnected from the primary grid and this limits the extent of the voltage fluctuations.

The disadvantages of this system are: (1) About twice as much primary circuit and load is deenergized when a primary feeder fault occurs as in the case of Fig 1, and (2) there are more locations at which equipment must be inspected and serviced.

TABLE III—Relation Between Maximum Instantaneous Symmetrical Faults and Substation Ratings and Spacings

(Assuming Uniform Spacing Between Substations and Length of Tie-Feeders Equal to the Spacing)

Rating of Network Subs KVA	Maximum Total Fault MVA				
	½ Mile Between Subs	¾ Mile Between Subs	1 Mile Between Subs	1½ Miles Between Subs	2 Miles Between Subs
1500	109	85	71	56	49
2000	147	115	96	76	66
2500	173	133	113	90	79
3000	197	153	128	104	91
3750	235	181	154	125	111
5000	283	217	187	155	138

TABLE IV—Relation Between Maximum Instantaneous Symmetrical Faults which Substation Transformer Breaker Must Interrupt and Substation Ratings and Spacings

(Assuming Uniform Spacings Between Substations and Lengths of Tie-Feeders Equal to the Spacing)

Rating of Network Subs KVA	Maximum Fault MVA Through Transf. Breaker				
	½ Mile Between Subs	¾ Mile Between Subs	1 Mile Between Subs	1½ Miles Between Subs	2 Miles Between Subs
1500	84	60	46	31	25
2000	114	82	63	43	33
2500	131	92	71	48	42
3000	147	103	78	54	50
3750	172	119	91	63	63
5000	200	133	104	83	83

TABLE V—Relation Between Maximum Instantaneous Symmetrical Faults which Substation Tie-Feeder Breakers Must Interrupt and Substation Ratings and Spacings

(Assuming Uniform Spacing Between Substations and Length of Tie-Feeders Equal to the Spacing)

Rating of Network Subs KVA	Maximum Fault MVA Through Tie-Feeder Breakers				
	½ Mile Between Subs	¾ Mile Between Subs	1 Mile Between Subs	1½ Miles Between Subs	2 Miles Between Subs
1500	88	70	60	48	43
2000	119	95	80	65	58
2500	140	110	95	78	70
3000	160	127	109	91	81
3750	192	151	131	110	99
5000	233	183	161	137	124

TABLE VI—Relation Between Maximum Instantaneous Symmetrical Faults which Breakers Located at the Mid-Points in the Tie-Feeders Must interrupt and Substation Ratings and Spacings

(Assuming Uniform Spacing Between Substations and Length of Tie-Feeders Equal to the Spacing)

Rating of Network Subs KVA	Maximum Fault MVA Through Mid-Point Tie-Feeder Breakers				
	½ Mile Between Subs	¾ Mile Between Subs	1 Mile Between Subs	1½ Miles Between Subs	2 Miles Between Subs
1500	31	22	18	13	10
2000	42	30	24	17	14
2500	48	35	28	20	16
3000	53	39	31	22	18
3750	62	46	37	27	22
5000	73	53	43	31	25

In view of the fact that most faults—80 or 90%—are of a temporary nature, the disadvantages of this system are not serious, and it is surprising that it is used so very little.

The substations for the "one-breaker" system of Fig 3 are even simpler than those described in connection with the "two-breaker" system of Fig 1. Each substation (Fig 4) consists of a three-phase tap-changing-under-load transformer and a transformer breaker usually built as a unit. The transformer breaker is tripped by network relays when a transformer or substransmission circuit fault occurs, and when so tripped it is also reclosed by the same relays. When a feeder fault occurs the transformer breaker is tripped, by means of overcurrent relays. If tripped by the overcurrent relays, the breaker is arranged to go through the usual reclosing cycle used on the primary-feeder breakers of radial systems.

III—No Tie-Feeder Breakers

The third form of primary network system which has been used by one company apparently very successfully is shown in Fig 5. In this system, all primary-feeder breakers are omitted and the primary feeders are connected together solidly to form the grid. The thinking behind such a system is that practically all faults on an overhead open-wire grid will become arcs and these arcs will be self-clearing. Should a primary-feeder fault fail to develop into an arc and clear itself the transformer breakers in all substations feeding the grid will trip and deenergize the system. To be sure of disconnecting all stations and to limit the extent of the outage, should a non-clearing fault develop, the size of such a simplified primary network will usually be limited to three or four substations feeding a relatively small grid. The radial feeders, particularly if small in size or long, will usually be fused. The substations used in this system are similar to those used in the "single-breaker" system.

Determining Breaker Duty

A primary network system is somewhat more difficult to design than a radial system. The tie feeders must be adequate to carry both load and emergency transfer currents, and must have impedance characteristics which will provide adequate voltage both under normal and emergency conditions. The transformer and feeder breakers must have sufficient interrupting capacity not only to take care of present conditions but also any reasonable future conditions.

Short circuit duty is dependent upon many variables such as size, number, and spacing of substations, and size and spacing of tie feeder conductors. Tables I to VI inclusive should be helpful in selecting the interrupting ratings of circuit breakers for use in any 4,160-v primary network system. Table I gives the ratings of standard network substations and the suggested capacity and sizes of the tie feeders to go with each size of station. Table II gives the relation between load density and the uniform spacing of various size substations. In this table it is assumed that the substations can normally be loaded up to their self-cooled rating and the capacity to take care of a subtransmission circuit out of service is provided by forced-air cooling. Tables III through VI give total fault MVA and fault MVA through transformer and feeder breakers for various sizes and spacings of substations. The MVA values given in the tables were obtained from calculating board studies using the tie-feeder sizes given in Table I and 6% impedance transformers.

The loading of substations and control of voltage are more difficult in a primary network system than in a radial system. This is because the substation transformers are operated in parallel through the primary grid from which loads may be tapped at any point. In order to get satisfactory loading of the substations, there should be about the same voltage, both in magnitude and phase angle, on all substation transformers. This usually means that all substations should be fed from the same bulk-power station.

Loading and Regulating

Adequate voltage control for the primary network system is ordinarily obtained by tap-changing-under-load equipment on the substation transformers. If this equipment gets very much out-of-step it produces a circulating component of current which adversely affects the loading of the substations. If it is attempted to raise the voltage on the substation buses with increase in load an unstable operation of the regulating equipment may be produced. To prevent this it is usually necessary to limit the amount of over-compensation attempted, and to reverse the reactance elements in the compensators so as to

(*Continued on page 143*)

Better Seal... Simpler Mounting

FOR OPTICAL ASSEMBLIES OF LARGE LUMINAIRES

Mr. A. G. Ottenheimer, General Electric Lighting Specialist of Chicago shows how new casing clamps hook over lugs of standard Form 101 hood.

Now General Electric engineers offer a new way to mount the large "A" type casings to Form 79 and 101 hoods. An external clamp hooks onto existing lugs on the outside of the hood. You simply hang the casing in place—lock it there by tightening the clamp screws.

This is only one more step in General Electric's efforts to help you achieve complete interchangeability and standardization of equipment. And, at the same time, it offers the benefits of better sealing, easier wiring, simpler mounting, and simpler assembly.

Here are some of the advantages:

1 Better Seal—Tightening the clamp screws compresses a cork gasket makes a far better seal between hood and casing.

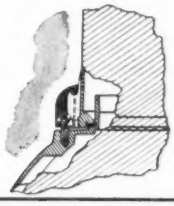
2 Easier Wiring—Casing and hood are shipped unassembled. All wiring is done *before* casing is attached.

3 Standardization—The same hood that has been used with standard utilitarian reflectors can now be used for Type A optical assemblies without drilling of holes or any other alterations.

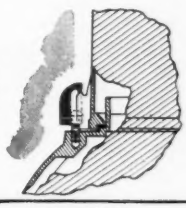
4 Improved Appearance—Trim die-cast aluminum clamps cover the lugs on the hood.

5 And of Course, Much Simpler Assembly—No small parts to handle—clamps are loosened, not disassembled. No hidden holes to find. No balancing act—casing can be hung on hood and screws tightened later.

This new G-E clamp assembly is another of the many improvements General Electric has developed for better street lighting. For complete details call your Apparatus Office or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Clamp, which is now used to mount Type "A" casings, is of die-cast aluminum, so shaped that it slips over and hooks onto lug on hood. Elongated screw holes in its base permit it to be moved toward or away from hood. With clamp backed away, casing is fitted against hood. Clamp moved in, it supports casing. Tightening the two screws locks clamp in place, draws casing with its cork gasket against hood.



Are you tying in with the NEMA plan to give America better street lighting?

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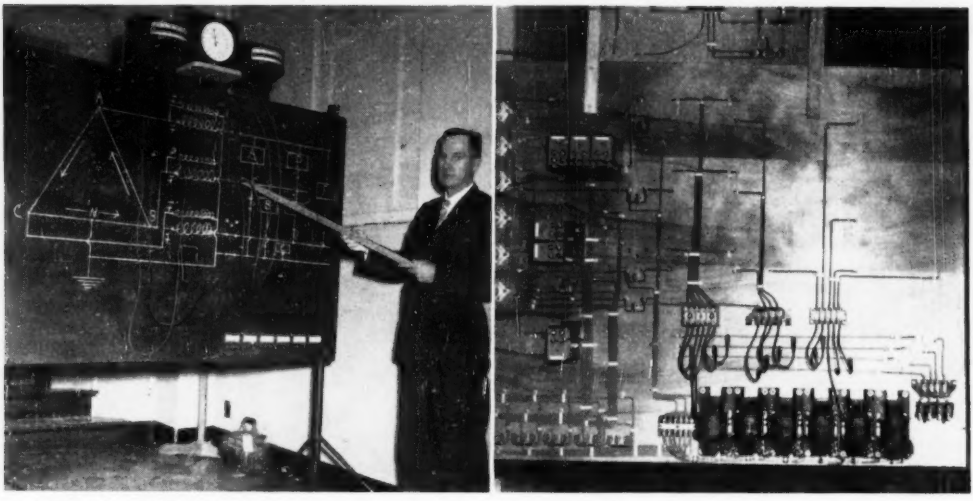
HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

Wired Blackboard Serves as Metermen's Training Aid



METERMAN TRAINING BOARD carries diagram of connections for power source, wattmeter and loads (A to F), with jacks for voltmeter, phase-angle meter and ammeter mounted at the top. Rear of board has actual wire connections and load devices

J. C. McPHERSON
District Meter Supervisor
Central Power & Light Co
Corpus Christi, Texas

MEASUREMENT of current or voltage by the individual elements of a wattmeter can be exhibited on the training board illustrated. This form of visible instruction is used by Central Power & Light Co at Corpus Christi in a training course for electrical metermen.

Visible to All

Outstanding feature of the wired board is that everything done can be easily seen by the entire class. The exact place the test is made in the circuit and the polarity of the instrument used (leads have colored plugs) can be seen by each student.

The training aid consists of a blackboard with appropriately located jacks and switches so that any metering circuit (correct or incorrect) can be shown. Rear of the board is wired with resistive, capacitive and inductive loads across any combination of load leads. Loads are selected at will by use of small toggle switches on the front of the board. Over 250,000 combinations can be made with this arrangement of switches and loads.

Three connection blocks in conjunction with a line bus permit the matching of the wiring with the drawing on the board. The first right-hand block with five flexible leads and clips is used to duplicate the line source. The second block with four leads duplicates the current leads of the meter. The third block with six leads matches up the potential connections as indicated by the metering diagram.

Test jacks on the face of the blackboard permit opening the circuits at any point where an ammeter or phase-angle meter is to be connected. The wattmeter drawing can be replaced with an actual instrument if desired. Jacks for voltmeter leads are available for any voltage checks needed. The voltmeter, ammeter and phase-angle meter are connected as a unit so that only four leads are required for all instruments, that is, two voltage leads and two current leads.

Incorrect Connections

Meter circuits can be connected incorrectly deliberately in order to determine the registration under that condition.

Load consists of the following:

(1) Six 20-mf capacitors.

(2) Six inductances made by winding 250 turns of No. 18 dcc wire on cores of L-3 current transformers. A slot about $\frac{3}{16}$-in. wide was then cut in the core. The current in these inductances is about 2 amp lagging 32 deg. The inductance in load A has 400 turns taped at 250 turns. The 300-w, 250-v lamps in series with

this is the Voltage Regulator...

General Electric's present-day Induction-type Feeder Voltage Regulator comes as close to being maintenance-free as any electrical equipment with moving parts.

Since there are no arcing contacts in the IRS regulator, designers were free to seal the tank completely. By doing this, they sealed out atmospheric air, moisture and other contaminants. The life of the insulating oil—and consequently the regulator—is greatly prolonged.

These regulators give accurate, stepless regulation, with no time-delay. They respond immediately to voltage changes and will provide correction at an average rate of one per cent in $1\frac{1}{2}$ seconds throughout the entire range of ± 10 per cent regulation.

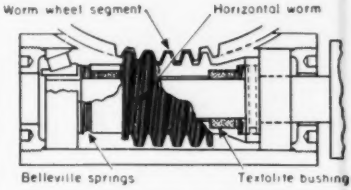
Write for Bulletin GEA-2985C which gives a full description of the Type IRS induction regulator—of its basic design which has been standard for eight years, and of the refinements, particularly in control-panel arrangement, which have recently been incorporated at the suggestion of users. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

● RESPONDS TO VOLTAGE VARIATIONS —IMMEDIATELY

The IRS Induction Voltage Regulator provides smooth, stepless voltage correction without the retarding action of a time delay relay which wastes investment because of *idle* regulation.

● FEWER PARTS TO WEAR FEWER PARTS TO MAINTAIN

The IRS Induction Regulator has *only three shafts* (including the motor) . . . all mounted in roller or ball bearings, all operating under oil.



Details of Spring-cushioned Worm

● NON-CHATTERING LONG-WEARING GEARS

One gear train, a double-worm reduction, provides a drive which is simple, silent, self-locking and *positive*. There are no ratchets, pawls, or chains to introduce uncertain operation and questionable life.

● SIMPLE DYNAMIC BRAKING

The capacitor, that gives the motor its high starting torque, automatically provides strong braking action when the motor supply circuit is opened. No separate braking circuits are needed. There are no mechanical devices to adjust.

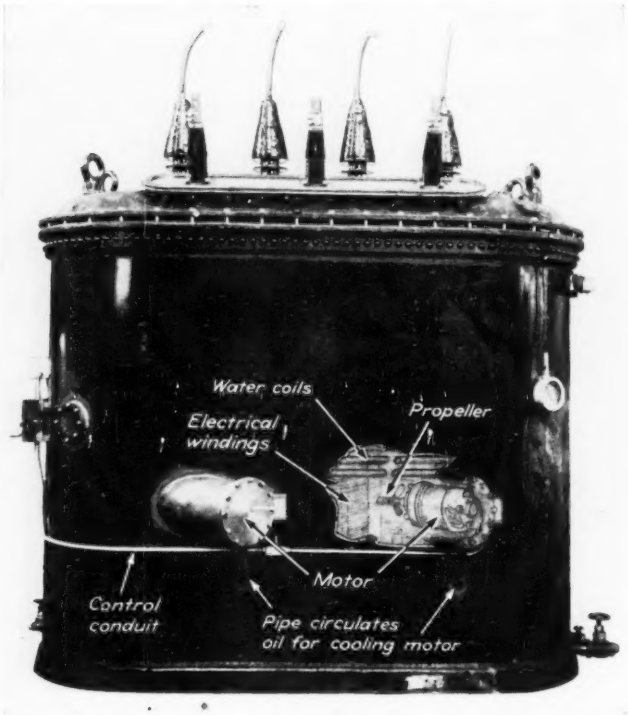
GENERAL ELECTRIC

inductances in loads D, E, and F were selected to give the phase angle desired in these loads. In making these inductances it is important that the current wave form be checked with an oscilloscope to guard against an irregular pattern. Insert series resistors or widen slot until the wave form approaches a sine wave.

(3) Lamps used as resistive loads are as follows: 300-w, 250-v lamps makeup loads A, D, E and F; 200-w, 120-v lamps makeup loads B and C.

The board is mounted on pipe supports and is fully equipped. A 240-v, 4-wire delta or 120-v, 4-wire wye power supply is all that is necessary to complete the installation.

Transformer Capacity Increased by Propelled-Oil Cooling



ABOUT 50% MORE capacity is obtained from this 8,500 kva OIWC transformer by propelled-oil cooling. Marine-type screw propellers impart horizontal motion to cooling oil

RALPH H. COOK
Engineer
The Detroit Edison Co

FOR HIGH PEAK LOADS or emergency and standby requirements, transformer capacity has been economically increased to 160-170% of nameplate rating by applying supplementary "propelled-oil" cooling to certain core-type units.

Often two transformers supply a common distribution system, for example. For such an installation, the capacity of each transformer is selected to provide emergency capacity in the event cable failures or other breakdowns remove one transformer from service. But because of load growth, the continuous load normally carried by the two transformers may have increased so much that a single transformer can no longer safely carry the total load in emergencies. Often, by applying the auxiliary cooling system, installation of larger transformers or a standby unit can be postponed.

In one instance, the capacity of a substation was increased more than 50%. The station used several 8,500-kva, 24,000-4,800 v 3-phase water-cooled core type transformers, with interleaved primary and secondary windings. In as much as they were closely designed, the capacity could not be increased by increasing the water rate or by forcing oil past or through the windings in the direction determined by normal convection cooling.

Temperature Differential

Because of their internal construction, very little oil movement took place in the spaces formed between the disk coil and coil spacers. The sluggish movement of this oil resulted in a low rate of heat transfer to the adjacent oil. This produced a high temperature differential between the winding copper and the surrounding oil, thereby limiting the output.

The transformer capacity was increased by mounting four motor driven marine-type screw propellers in tubular housings at an elevation of winding center, as shown in the illustration.

The axes of the propellers are in a plane at right angles to the axes of the windings, and the propellers are directed to force the oil tangentially toward the windings. Thus, the whole mass of oil is set in horizontal motion, which is in a direction at right angles to the normal flow of convection cooling. Velocity of the oil is approximately 5 fps. The eddies, caused by the horizontal flow of the high-velocity oil passing the open pockets (formed by the concentric disk coils and coil spacers), remove the heated oil from the pockets and replaces it with cooler oil, thereby increasing the heat transfer from the winding to the oil.

Horizontal Scrubbing

The horizontal scrubbing action of the relatively high-velocity oil removes the more viscous oil in contact with the water-cooled copper tubes. Previously, this envelope of more viscous oil thermally segregated the hotter oil from the water tubes,

Hold-Closed

till the right fuse blows

a new concept in recloser operation!

G-E invites you to consider a different concept, the alternate operating function built into the FR-1 Recloser. Suppose a recloser, after its two instantaneous openings, HOLDS CLOSED *but only until the right fuse blows*—then automatically resets for instantaneous openings—ready to again clear temporary faults. What then?

FIRST— Fewer reclosers would be needed for complete protection. Where reclosers would ordinarily be required, you could use co-ordinating fuses instead.

SECOND— Fewer consumers would be affected by permanent faults, because the "hold-closed" function lets you use more co-ordinating fuses. You can break up a feeder into five, six or even more sections, each protected by a progressively smaller fuse. When the recloser holds-closed, it *forces* the *right fuse* to clear a permanent fault, thus confining outages to smaller areas.

THIRD— You can pick up the load after an outage without by-passing the recloser. No need to worry about inrush and motor starting currents because the recloser can't lock open—it holds closed, picks up the load, then automatically resets to normal position.

General Electric believes that on rural lines, this "hold-closed" function is the answer to lower cost protection, fewer outages per consumer and faster service restoration. Therefore, its new recloser, the FR-1, has been designed to embody this exclusive "hold-closed" function. Conversion from conventional operating function to "hold-closed" function can be made in the field. With this "hold-closed" function, the recloser opens twice instantaneously, each opening followed by a 1-second reclosing. This clears non-persistent fault without damage to fuses. If the fault is persistent, the recloser then ***holds closed***—but only long enough for the fuse to blow and clear the fault—whereupon the recloser quickly resets, ready to go again.

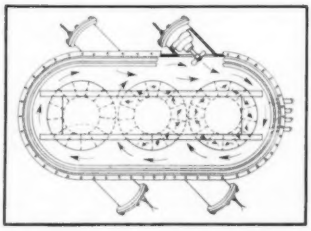
The FR-1 recloser can also be used with the conventional operating function—two instantaneous openings, plus two time-delay openings, to lock open. Because the time-delay openings are controlled by a highly accurate mechanical-escapement timer, operating in air, the FR-1 is not affected by temperature or condition of oil—thus permitting *reliable* year-round co-ordination with more ratings of fuses than any other conventional lock-open type of recloser. Because the FR-1 resets 5 times faster it gives more protection.

For the full story on the new "hold-closed" Function, including complete application information, write for Bulletin GER-131. Apparatus Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

thereby reducing the thermal capacity of the water tubes to dissipate the heat externally, regardless of how much the normal water flow was increased above an optimum rate.

The cooling system does not interfere with the normal cooling, and does not lower the electrical clearances since baffles are not used. The motors are electrically connected in diagonally opposite pairs, the pairs being operated singly or simultaneously, depending on the unit's load. It is uneconomical to operate continuously at the full increased rating, because the inherent losses in the lower rated windings become excessive above a certain load.



OIL IS FORCED tangentially towards the interleaved primary and secondary windings

Because of the more rapid change in the volume of oil immediately in contact with the surface gas, the space above the oil is filled with nitrogen to eliminate the slugging of the oil and the oxidization of insulating material.

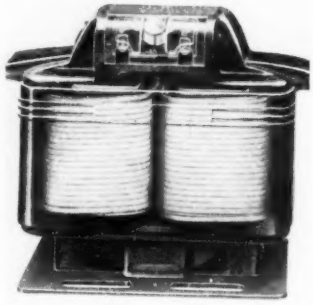
Several transformers so converted have been in service for five years and have been operated satisfactorily during the peak load periods. Since the first installation similar installations have been completed in two more substations and more are currently contemplated.

As a public service, The Detroit Edison Co offers this patent to the industry. The patent, No. 2,419,439, "Cooling System For Transformers", was issued on April 22, 1947 to the author and subsequently assigned to The Detroit Edison Co.

Current Transformer Now Butyl-Molded

I. F. KINNARD
Manager of Engineering
Meter and Instrument Divisions
General Electric Co, West Lynn Works

IT HAS LONG been the goal of instrument-transformer engineers to develop a method of molding or casting an insulating material around the transformer core and coils, thus eliminating the necessity for hand wrapping. After considerable experimentation such a method, as well as a material suitable for use with the method, has been developed through the joint efforts of several divisions within the General Electric Co. The result is the butyl-molded current transformer of unit construction, with all the component parts firmly molded together in a continuous casing of butyl. Twenty-nine materials had been tried with various molding and casting techniques but they tended to crack during temperature cycling which expanded and contracted the metal parts of the transformer. In addition, they were difficult to mold or cast without voids.



PHANTOM VIEW of butyl-impregnated and butyl-encased current transformer

Ideal Compound

Late in 1945, butyl was tried with very promising results. Butyl is flexible enough to withstand extreme dimensional change in the metal parts, and the pressure used in molding gives a dense, homogeneous insulation with no voids. A special compound was developed specifically for instrument-transformer molded insulation. Properties of the special butyl compound were found to be ideally suited for the purpose.

The cutting resistance, tear resistance, thermal conductivity, and resistance to abrasion of the butyl selected are all high. It has an elongation of 680% and mechanical shocks will not crack the insulation, but will flex it slightly. The remarkably stable chemical properties make it ideal for almost all conceivable conditions. Dielectric strength of butyl under 60-cycle insulation breakdown tests averages approximately 400 v per thousandth of an inch for samples $\frac{1}{8}$ in. in thickness. This is almost double the comparable value for asphalt-impregnated paper. In contrast to that of other materials, moreover, this dielectric strength remains high even when the temperature of the insulation is raised to a level far above the normal operating range. In the case of butyl, the power factor of less than 1.0% falls well below that of most other solid dielectrics.

Arc-tracking tests show that butyl will withstand 130 sec of repeated arcing, compared with 7 sec for ordinary phenolic materials; 90 sec for polyethylene; and 130 sec for asphalt-impregnated paper. Results of tests indicate that butyl-insulated transformers should have a longer service life than superseded types that are insulated with impregnated-fibrous material.

Temperature Tests

Effect of repeated change in temperature and humidity conditions was checked by cycling a group of 4 transformers between −40 C, +75 C, and 90% relative humidity at 40 C. The transformers were left, without voltage or current, in each condition for 24 hours and were moved directly from one condition to the next. Eleven hundred hours of test have been recorded without incident.

The first design to incorporate the new technique of molding butyl insulation around the transformer parts is suitable for 5,000-v service and is made in all the ASA current ratings from 10 through 800 amp.

Here are the NEW STANDARDS in G-E high-voltage distribution transformers

Now listed. Now in production.

Standard Ratings
(Single Phase*)

22,900	High Voltage	34,400
24,100	Tap Voltages	36,200
23,500		35,300
22,300		33,500
21,700		32,600
Kva	**Low Voltage**	**Kva**
25,	2400/4160Y	50,
50, 100,	4800/8320Y	100,
167, 250,	7200/12470Y	167, 250
333, 500	7620/13200Y	333, 500
250,	2520/4360Y	250,
333,	5040/8720Y	333,
500	7560/13090Y	500
	7980/13800Y	
43,800	**High Voltage**	**67,000**
46,200	Tap Voltages	70,600
45,000		68,800
42,600		65,200
41,400		63,400
Kva	**Low Voltage**	**Kva**
50,	2400/4160Y	100,
100,	4800/8320Y	167,
167, 250,	7200/12470Y	250,
333, 500	7620/13200Y	333, 500
250,	2520/4360Y	250,
333,	5040/8720Y	333,
500	7560/13090Y	500
	7980/13800Y	

*For standard three-phase ratings, see G.E. Apparatus Handbook Sect. 5420.

NOW IN LINE WITH "PREFERRED VOLTAGES"

The table at the left lists the ratings which are now standard for General Electric distribution transformers with high voltages above 15,000. These voltages, both on high and low sides, are in accordance with recommendations of the E.E.I.-NEMA Joint Committee on Preferred Voltages. Standard taps are no longer based on a percentage of rated high voltage. Instead, there are two tap voltages above and two tap voltages below rated high voltages—all listed as "preferred."

A TWO-YEAR-OLD STORY—BROUGHT UP TO DATE

This move is a continuation of General Electric's policy introduced in April, 1947—to give transformer users the benefits of quantity production of *standard* products. At that time, transformer ratings below 15,000 volts were changed to conform to industry-wide preference as indicated in the E.E.I.-NEMA Fourth Report. *Now* this program has been extended to include the higher voltage ratings. *Now* the benefits of standardization—lower price levels, faster shipments and improved quality—are available to users of G-E Standard distribution transformers in *all* voltage classes.

FAMOUS SPIRAKORE QUALITY

In these new standard transformers, you still get the Spirakore features that have made General Electric distribution transformers the quality leaders of the industry. You get—

Sealed tank construction—that protects the insulating liquid from moisture and other contaminants in the surrounding air.

Attractive, weather-resisting, Glyptal finish—proved by years of outstanding service to be the most durable of protective finishes—recently improved.

Wound cores of corisil steel which make possible small, lightweight transformers.

Progressive-layer insulation and shielded winding—the combination that gives G-E distribution transformers their remarkable impulse strength.

In short, with these new standard ratings, you get the finest transformers we have ever built—the finest you can buy. *Apparatus Department, General Electric Co., Schenectady 5, New York.*

Spirakore Transformers

GENERAL ELECTRIC

Select Economical Feeder Size

HUGH VAN HORN, Senior Engineer, Georgia Power and Light Co, Valdosta, Georgia

CHART OFFERS a quick solution of Kelvin's Law for average operating costs and loads. That is, it determines the conductor for which the annual cost of losses equals the annual cost of fixed charges which is the optimum condition.

Optimum wire size according to Kelvin's Law will be found at intersection of lines D and G if the load is concentrated at the end of the feeder, and at the intersection of lines D' and G if the load is evenly distributed along the feeder. Losses due to distributed load are ⅓ of losses due to load concentrated at the end of feeder.

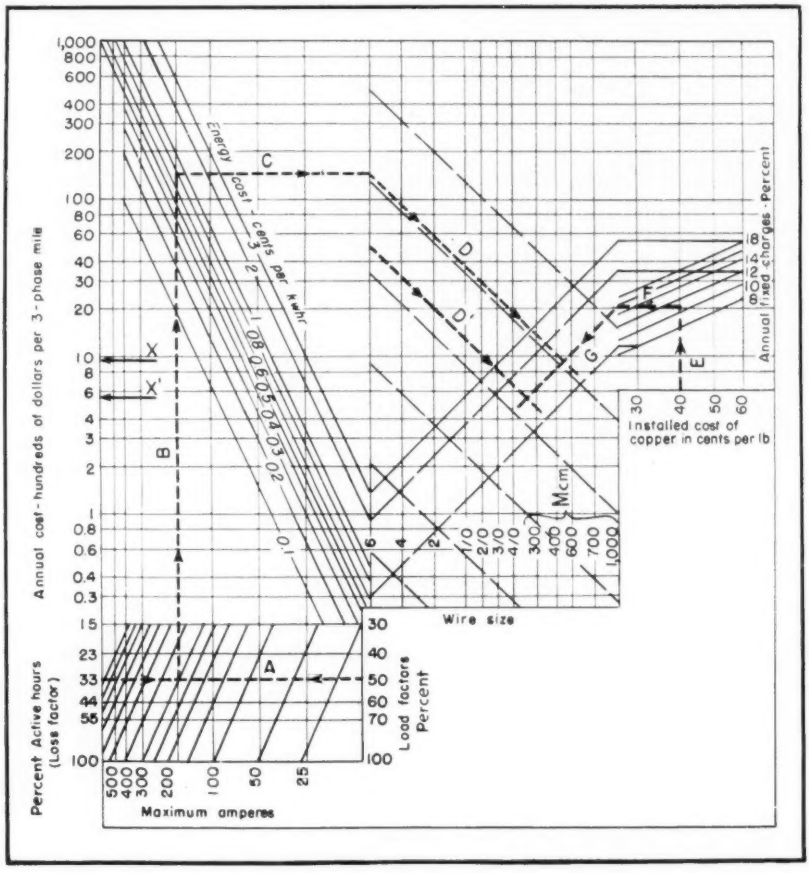
Cost of either losses or fixed charges is that indicated by arrow X in the case of concentrated load and by arrow X' in the case of distributed load.

Example: Assume a 2,400-v, 3-phase, one-mile long feeder with 50% load factor or 33% loss factor, a maximum current of 300 amp, an energy cost of $0.008 per kwhr, an installed copper cost of $0.40 per lb and an annual fixed charge of 11%.

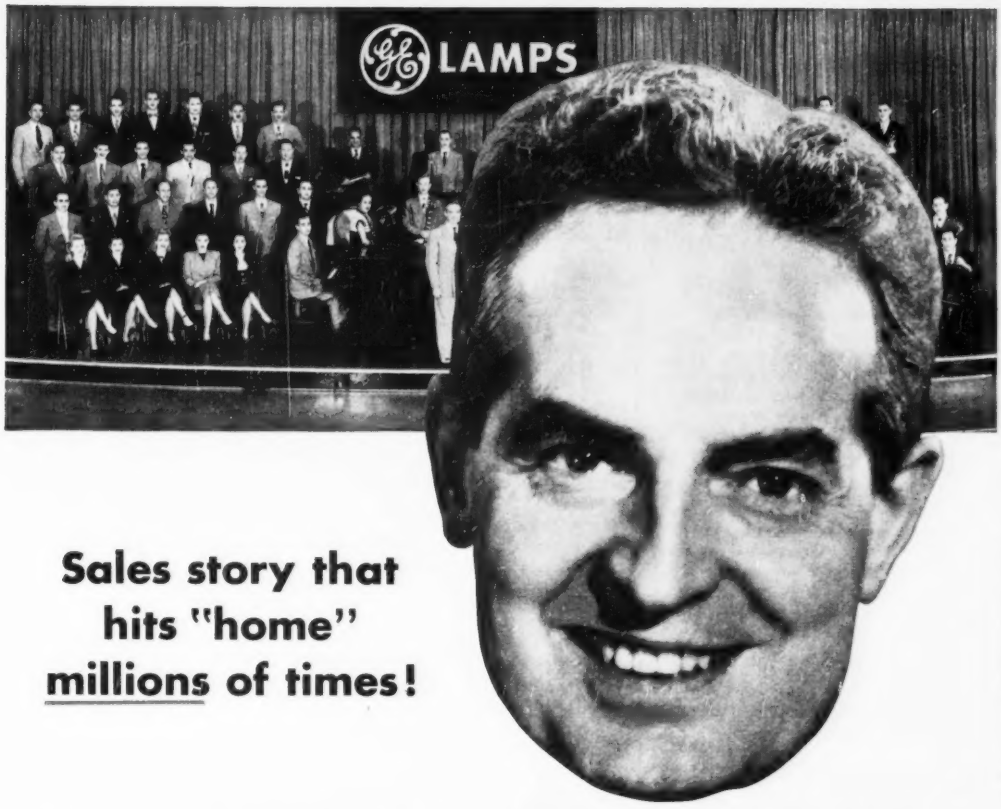
Most economical wire size for this feeder with load concentrated at end is 450,000 cir mil copper. From the left hand scale at a point (arrow X) opposite the intersection of lines D and G read $930. This is the annual cost of losses and also the annual cost of fixed charges. The total annual cost is $1860.

Most economical wire size for this feeder with load distributed along the feeder is 250,000 cir mil copper. From the left hand scale at a point (arrow X) opposite the intersection of lines D' and G read $540. This is the annual cost of losses and also the annual cost of fixed charges. The total annual cost is $1080. The above annual costs are within 1% of calculated values. The annual costs are directly proportional to the length of the line.

Cost of losses or fixed charges for any other than optimum wire size may be found at intersection of either lines D, D' or G with the vertical line for that wire size.



Note: Loss factor and percent active hours are empirically related to load factor (lower left section of chart) in the manner indicated by "A Method to Compute Annual Losses on Lines and Transformers" in Electrical World, January 5, 1946, page 98.



Sales story that hits "home" millions of times!

THE FRED WARING RADIO SHOW

Selling G-E Lamps every Thursday evening over NBC coast-to-coast

EVERY Thursday evening Fred Waring and a brilliant cast of 60 stars are reaching millions of homes from coast to coast to help you set new sales records with G-E Lamps and other General Electric products.

It's a bright, sparkling show that catches customers' ears with good music, fun, and the cleverest commercials on the air, all aimed at building lighting load. The Fred Waring Show is one of your best salesmen, with sales-talks that are sure to ring the bell on your cash register.

The Fred Waring Show is *your* show . . . working for you . . . taking *your* story across the nation every week—making America more conscious of better lighting than ever before.

GENERAL ELECTRIC

Foundations for Wood Poles

II—Kinds of Self-Sustaining Foundations

FOLLOWING foundation methods are used for self-sustaining poles.

Log Heel—See Fig 1. Used with poles in place two or more years, equivalent in strength to log heel and stone toe. Fit log between undisturbed earth and pole as snugly as possible.

Double Log Heel and Stone Toe—See Fig 2. Used to prevent sideward leaning on poles supporting transformers weighing over 950 lb. Logs are installed parallel to through-going wires and should fit snugly between pole and undisturbed earth. Pole in place two or more years can be considered as having a stone toe.

Log Heel and Stone Toe—See Fig 3. Used for loads in one direction. This is the preferred method. Use force-fit to make front of log fit snugly against undisturbed earth for as much of its length as is reasonably possible.

Stone Heel and Toe—See Fig 4. Used for loads in more than one direction and in place of log heel and stone toe where log is difficult to install. Illustration serves likewise for full concrete heel and toe.

Full Concrete Heel and Toe—See Fig 4. Used in place of stone heel and toe when greater strength is required. "Full" means on pole circumference.

Partial Concrete Heel and Toe—See Fig 5. Used in place of log heel and stone toe when greater strength is required. Amount of concrete shown on sketch is total for heel and toe.

Barrell Construction—See Fig 6. Used in quick sand or marsh. Note: If earth caves in, fill with large field stones. Crushed stone may be used if field stone is not obtainable locally.

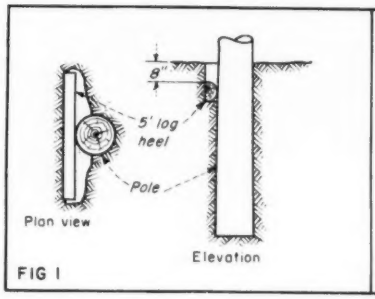


FIG 1

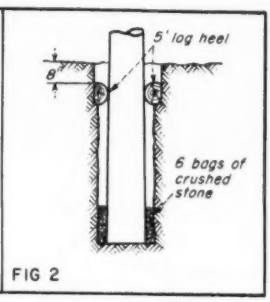


FIG 2

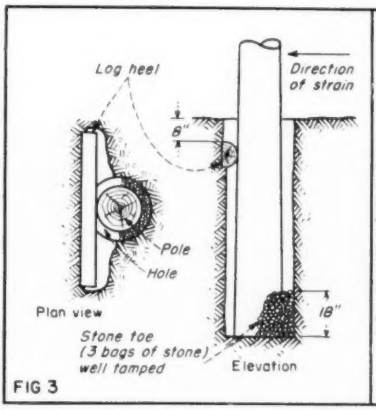
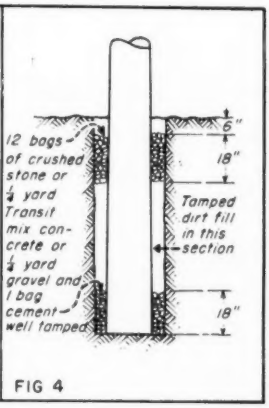


FIG 3


12 bags of crushed stone or ¼ yard Transit mix concrete or ¼ yard gravel and 1 bag cement well tamped
6"
18"
Tamped dirt fill in this section
18"
FIG 4

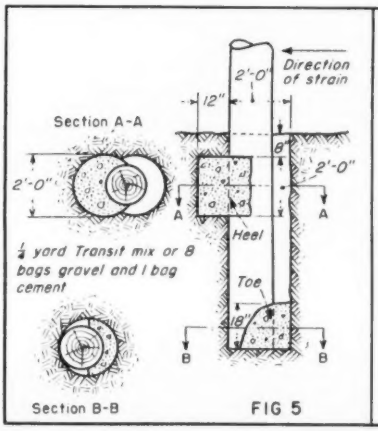


FIG 5

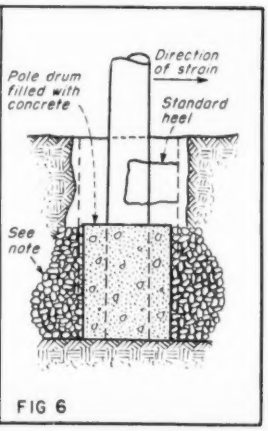


FIG 6

An adaptation from overhead lines standards of Detroit Edison Co.; continuation of a four-part serial which began in Electrical World, page 92, June 4, 1949. Illustrations have sequence numbering throughout the series of articles.

2 REVERE

CORROSION-RESISTANT COPPER ALLOYS

are again selected for two tough jobs in the chemical industry

1 REVERE CUPRO-NICKEL 70-30

among the toughest and most corrosion-resistant of the copper-nickel alloys!

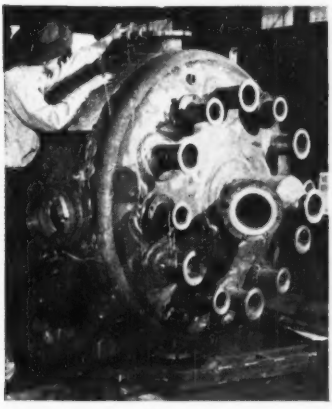
2 REVERE HERCULOY

versatile leader of the corrosion-resistant silicon-bronze alloys, exceptionally strong!

Recently the John Nooter Boiler Works Co. in St. Louis . . . well-known precision fabrication specialists . . . completed the two tough jobs shown here for the chemical industry.

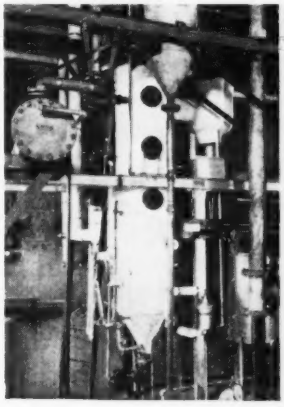
A calandria and six reactors, this is typical chemical equipment that demands the best in basic metals and fabrication methods . . . reliability with low maintenance cost.

Which is why two Revere copper alloys were specified . . . because Revere products and service are the soundest starting point for any manufacturer using copper and its alloys.



A Famous Chemical Manufacturer Uses Six of These Reactors As a Vital Part of Production.

Here again Revere has supplied the correct alloy for a difficult job. Revere's Cupro-Nickel 70-30 is the copper-base alloy most resistant to salt water corrosion. With its great resistance to failure by stress-corrosion and corrosion-fatigue, it is used when conditions are unusually severe. 70-30 Cupro-Nickel has high strength, high ductility . . . can be stamped, cold forged, drawn and bent. It is used for condensers, heat exchangers, and process equipment.



Washington University in St. Louis Ordered This Calandria for Research Work in Their Chemical Engineering Laboratory.

Revere's famous silicon-bronze alloy HERCULOY *supplies the necessary tensile strength and resistance to corrosion this combination still and heat exchanger requires.* HERCULOY *cold-works and hot-works readily, is easily welded by any of the commercial methods, has superior fatigue resistance, is used in operations requiring resistance to alternating and cyclic stresses. It has the corrosion resistance of copper plus the strength of mild steel.*

As the chemical industry is doing, more and more industries needing copper and copper-base alloys are turning to Revere for the best in service and guidance. Before placing your next order for copper or copper alloys, call your nearest Revere office. The Revere Technical Advisory Service will gladly collaborate with you.

REVERE

COPPER AND BRASS INCORPORATED

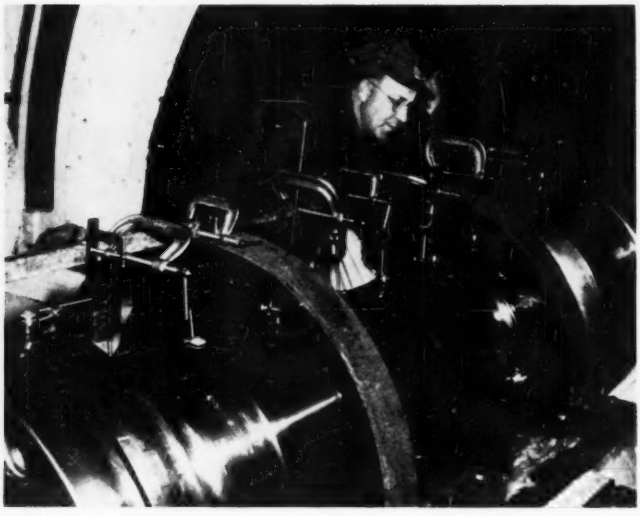
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Localized Heating Straightens 20-In. Shaft



LOCALIZED HEATING with acetylene torches successfully straightened this 20-in. diam frequency changer shaft without the need for removal from its bearings

A. JENKINS
Supervisor of Maintenance
Southern California Edison Co
Los Angeles

F. W. POLLARD
Consulting and Application Engineer
Westinghouse Electric Corp
Los Angeles

STRAIGHTENING a 20-in. diam shaft by applying localized heating saved Southern California Edison Co approximately $20,000 and 1 month outage on a badly needed 50,000-kva frequency changer. Using acetylene torches, workmen reduced to 1 mil a run-out of 35 mils at the coupling of the 105-ton rotor of the machine.

Damage to the machine, which may have been due to several severe system disturbances, was discovered after it began to vibrate excessively. Distortion of coupling holes and bolts in addition to the bent shaft indicated that the machine had been subjected to high torques.

Capacity of the 60/50 cycle machine was doubly important during Edison's frequency change, and time was a major factor in planning its repair. Size of the rotor—7½-ft diam, 105 tons—would have made removing and transporting it to a lathe for re-turning the journal and coupling a major job. The added disadvantage of keeping a special spare bearing for the resulting undersized journal also influenced the final decision to straighten the shaft without removing the rotor from the machine.

Local areas on the shaft were heated with two acetylene torches so the material in these areas exceeded the yield point in compression. When the shaft cooled the area was in tension and pulled the shaft back in the desired direction.

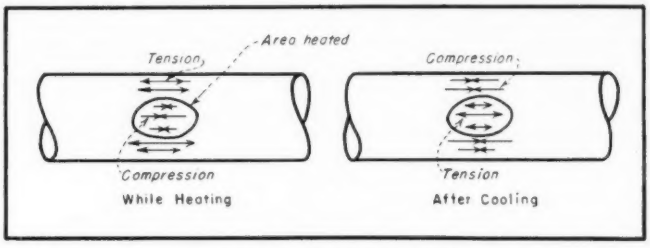
Run-out of the shaft was checked at different points by a system of dial indicators set above the journal as shown. From readings of the indicators as the shaft rotated in its bearings a curve was plotted to determine the point of sharpest bend. Outside diameter of the bend was then rotated to the top and heat applied to that area for approximately 7 min at a time by two torches. After each heating the shaft was allowed to cool and run-out checked all the way along the shaft. This determined how much had been accomplished and where to apply the next heat.

Several Heats Failed

The accompaning curves show the progress after each heat. No change was produced by the first heat, when one torch was used—heat was absorbed by the shaft faster than it was supplied. The third heat covered too much area, and heat No. 10 was not applied long enough. In each of these cases the spot was not heated enough to compress the metal. Best results were obtained when an area about 5 in. in diam was heated to a dull red.

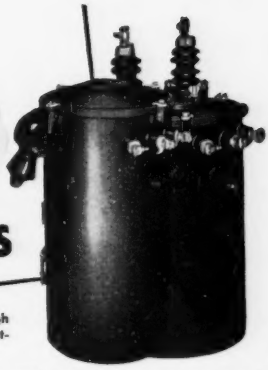
One complication resulting from use of this technique was radial swelling of the area where heat was applied. Height of swelled areas was about 2 to 3 mils. Since most of these spots were on the journal, it was necessary to stone them to make it round again. Final reading showed about 1½-mil maximum run-out on the journal, 1 mil on the coupling face and 1 mil on the outside coupling diameter.

New coupling bolts were made and fitted in the rebored coupling holes.



HEATING a small area on the high side of the bent shaft (left) set up compressive forces beyond the yield point. As a result, tension in the area after it cooled (right) gradually brought the shaft into true alignment. Radial swelling in heated area was removed by stoneing

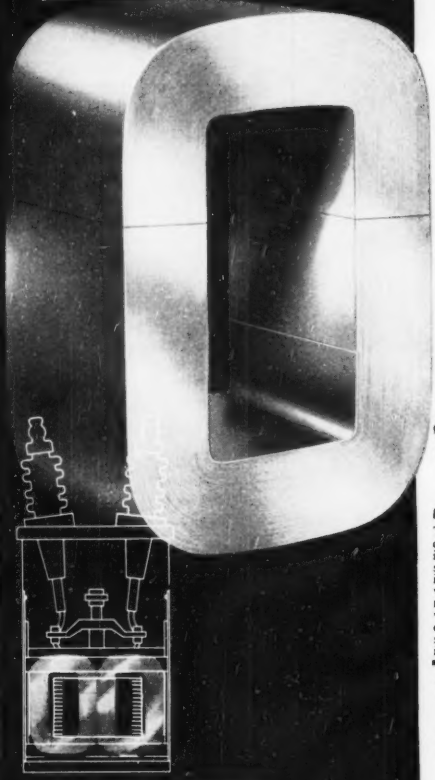
THE NEW MOLONEY *HiperCore** DISTRIBUTION TRANSFORMERS



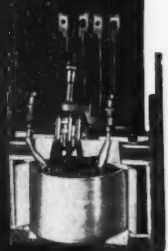
*Cores made of High Permeability, Oriented, Silicon Steel.

The new Moloney HiperCore Distribution Transformers incorporate advanced engineering practices and simplicity of construction, plus the usual Moloney high factor of safety in design. Cores are wound of high permeability, oriented, silicon steel having 30% to 35% greater flux carrying capacity than hot rolled steel.

HiperCore Transformers with wound cores, are lighter in weight and smaller in size than transformers having cores of non-oriented steel. They have greater short-time overload capacity and better voltage regulation. Simple construction and low winding temperature gradient result in trouble-free operation, longer life under all loading conditions.



Above: After cores are wound, they are annealed, impregnated and then cut into pairs of U-shaped pieces. Two large U-shaped pieces are placed side by side, forming an inner and two outer core legs. Then the windings are placed into position to complete the magnetic circuits. A thermo-setting adhesive bonds the core faces together. Steel bands are used to obtain tight joints. Complete core-and-coil unit at right.



Write for BULLETIN H-303 describing the New Moloney HiperCore Transformers

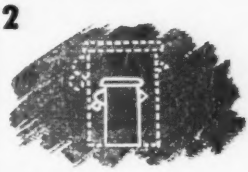
4 STAR FEATURES

1

LIGHTER WEIGHT

The 30% to 35% higher flux carrying capacity of the oriented core steel used in HiperCore Transformers makes possible the use of smaller cores and windings, with consequent reductions in the weight of steel, copper, oil, and other materials. HiperCore Transformers weigh 15% to 30% less than transformers having cores made of hot rolled steel, making them easier to handle and install.

2



SMALLER SIZE

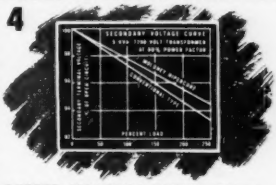
Since the higher flux carrying capacity of oriented steel permits the use of smaller cores and windings, smaller tanks can be used. Reductions in size range up to 30%. HiperCore Transformers take up less space on the pole, in the storeroom, and on the line truck.

3

GREATER SHORT-TIME OVERLOAD CAPACITY

Moloney HiperCore Transformers have improved short-time overload characteristics which provide better peak load performance and longer life. Reduced coil mass, achieved through use of oriented steel cores, together with the extensive use of cooling ducts, results in more rapid cooling of the windings and in a lower hottest-spot temperature gradient.

4



BETTER VOLTAGE REGULATION

The smaller cores of HiperCore Transformers make possible windings having lower impedance. Lower impedance provides lower internal voltage drop at all loads. This is especially important during peak load periods, since HiperCore Transformers can carry higher overloads than older types, at the same permissible regulation.

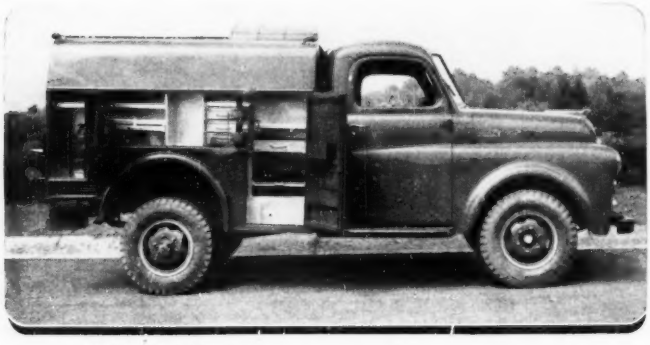
MOLONEY ELECTRIC CO.

Transformers Exclusively Since 1896

FACTORIES AT ST. LOUIS 20, MO. & TORONTO, ONTARIO, CANADA

YORK-HOOVER

Service Bodies SAVE MONEY for YOU because



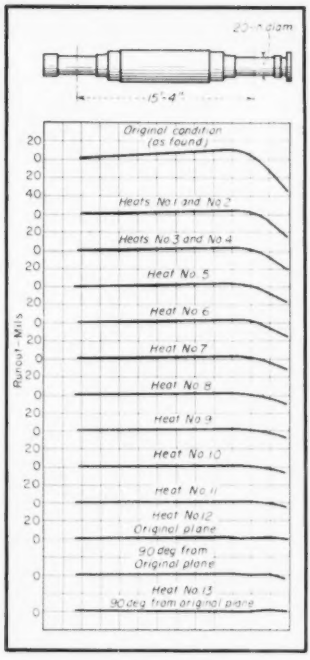
Model 2040

York-Hoover Line Service Bodies, for installation on ¾-1 ton chassis, are provided with complete working equipment.
Years of study and engineering experience have indicated the most adequate body interior arrangements so that all necessary service materials and tools are at the service men's fingertips.
There is a York-Hoover body design to meet your particular requirements and we will be happy to give you all details.

Write now for the York-Hoover "Public Utility" catalog.

1. All-metal body structure is balanced to produce minimum weight.
2. Exclusive body framework and assembly details result in many extra years of service.
3. Construction includes replacement parts study for maintenance economy.
4. Details of convenience for driver and garage personnel carefully considered.
5. Your body is engineered for your specific job — and yours alone.

YORK, BODY DIVISION CORPORATION PENNA



PROGRESSIVE CORRECTION of shaft curvature. Most effective correction was obtained by heating an area about 5 in. in diam to a dull red for about 7 min

alignment corrected and both units run independently before coupling. Vibration on the straightened shaft was less than ½ mil at each bearing. After coupling, maximum vibration of only 1.1 mil was measured on the coupling-end bearing of the 60-cycle machine.

Nineteen Guides to Safer Live Line Maintenance

THE FOLLOWING 19 safety precautions to be observed in the performance of live line maintenance were listed as essential by R. H. McAdams, Kansas Gas & Electric Co, Wichita, in discussing proper climbing and working clearance before the 1949 Engineering Conference of the Missouri Valley Electric Association.

1. Tools should be carefully selected for the job considering strength, insulating properties, mechanical adaptability to the job. Special consideration should be given to the strength of tools used on angle

THIS IS NO YARN...

I Just Mind My Knittin' Since I Got JOSLYN CERTIFIED PROTECTION!*

This *certified protection* is achieved by the combination of a Joslyn Lightning Arrester and a simplified cutout, using the Joslyn Overload Limiter Link in a compact assembly. It can be mounted easily on any cover bushing type transformer tank. The Joslyn Lightning Arrester has proven its ability to provide Positive Protection against all effects of lightning, regardless of its magnitude or duration!

Joslyn Overload Limiters are not new. They have established an outstanding record of performance in territories where lightning conditions are most severe. And today they are protecting thousands of distribution transformers in all parts of the country, demonstrating their ability to survive heavy lightning conditions and, at the same time, to provide adequate transformer overload protection.

(*Write for the new Joslyn Certified Protection bulletin*)

***Joslyn CERTIFIED PROTECTION will save your distribution transformers:**

1. From failures or flashovers caused by lightning—even direct strokes.
2. From burnouts caused by secondary shorts.
3. And even from harmful overloads.

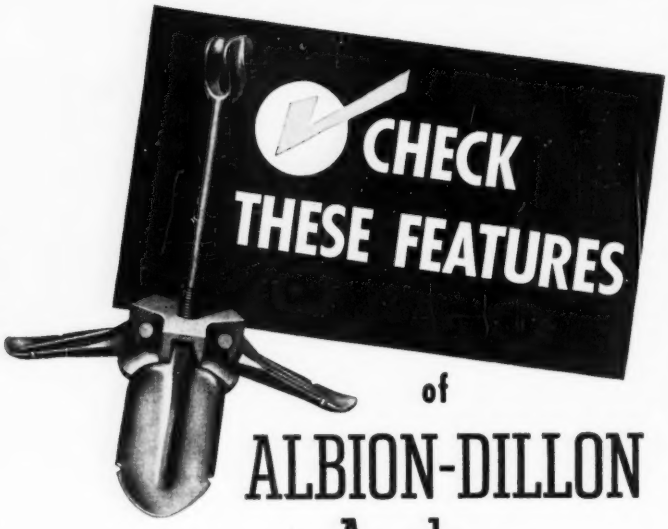
Branch offices in principal cities

THE JOSLYN CO.
THE SOUTH EAST-JOSLYN CO.
SOUTHERN JOSLYN CO.
JOSLYN SOUTHWEST CO.
JOSLYN PACIFIC CO.

JOSLYN MFG. AND SUPPLY CO.

Complete Pole Line Equipment

20 NORTH WACKER DRIVE, CHICAGO 6, ILL.



of

ALBION-DILLON Anchors

- Made of High-Strength Malleable Iron
- Economical in Price— Easy, Economical to Install
- Three Long Blades Extend Deeply in Solid Earth
- Lasting Strength Gives Them Lasting Holding Power
- Approved by R.E.A.— Selected by Leading Companies

For dependable guying under all conditions, rely on Albion-Dillon Expanding Type Anchors, made of malleable iron for *lasting* strength. Pull tests prove that A-D Anchors will withstand up to 46,000 lbs!

When you add up all the features, as listed above, you can understand why large companies are now specifying A-D Anchors in increasing numbers.

Send for Folder!

If you are not familiar with A-D Anchors, send for descriptive folder which includes specifications.

ALBION MALLEABLE IRON CO.
"One of America's Foremost Producers of Malleable Iron"
ALBION, MICHIGAN

construction and allowances should be made for side strain. When in doubt of strength use two pieces.

2. If in doubt as to safety of the work planned, do not attempt it until sure it can be done safely. Decide how the job is to be done before starting it.

3. Work should not be started when rain appears likely. If rain occurs, restore lines to position and remove tools as quickly as possible.

4. Do not wear rubber gloves when doing "hot-stick" maintenance as brush discharge cannot be detected. Tools showing brush discharge should be tested. Poles should be checked for weakness and decay; if need be, guy before work is begun.

5. Avoid holding onto braces or other metal attachments.

6. Do not hurry. Do not get excited or lose your temper. Do the job carefully and safely.

7. Foremen should not work, but should be in position to watch the work of the men, advising them of their safety and the proper use of the tools.

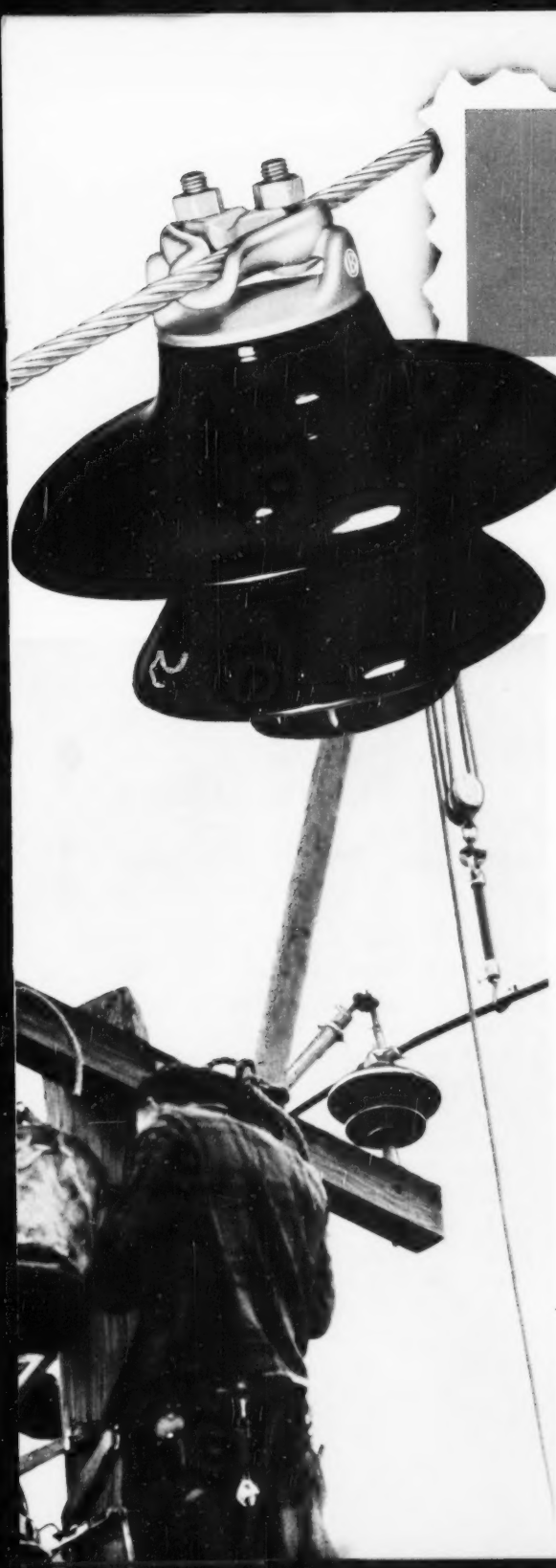
8. Close cooperation of every man on the job is essential.

9. A man who is unduly high tempered and fractious should not be allowed to do live line maintenance.

10. Unnecessary conversation should not be allowed, especially that which does not concern the work, as this detracts the attention of the men from the work, causing confusion and adding an unnecessary hazard to this type of maintenance.

11. Consider wood pole structures and steel towers alike. Don't depend on the insulating value of a wood pole.

12. The lineman should not depend upon such warnings as he may receive from current creeping over the surface of the insulated tools to warn him of his being too close to the line end of the tool, but should have some practical way of marking the tools that he will receive instant warning when he has reached the minimum distance for safety. One way to do this is by the use of a rubber or fiber collar on the tool, with the required distance specified for minimum clearance. By actual test, the break down, when it finally does occur, takes place directly between the live parts and the grounded metal parts of the test rack



HI-TENSION NEWS *Junior*

The Strongest Conductor Attachment *and the Safest*

"They're the slickest thing I've ever seen for hot line changes." This comment on O-B Clamptop insulators was recently made by a lineman just after installing one, hot. He knew what he was talking about. The job is not only easier but a lot safer.

Ease is the result of the O-B clamping principle. Two readily-accessible hex nuts accomplish the "tie". This is done quickly, and a simple adaptation of a regular hot-stick wrench can set these nuts tight. The full mechanical strength of the insulator is developed in this fashion, as contrasted to the much weaker attachment done with the ordinary hot tie.

It is commonly recognized that installation of a first-class tie wire, hot, involves a hazard. Danger of the loose end unexpectedly contacting another phase or reaching a man on the pole is always present. With O-B Clamptops, *there is no tie wire*—likewise, there is no such danger!

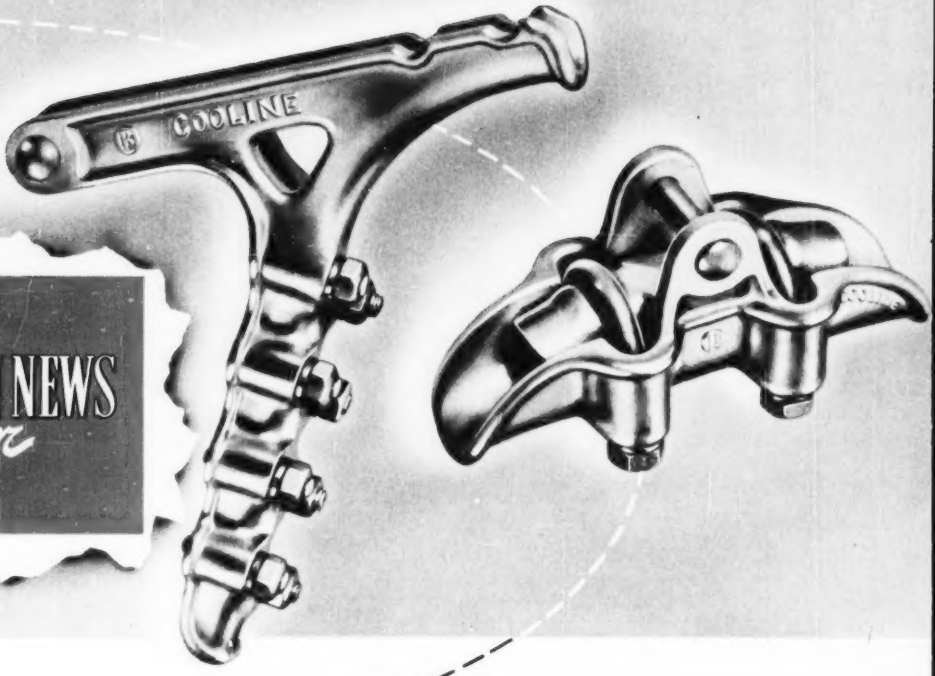
Since hot line work is so commonly done, today, consider the advantage of an insulator with all the basic features of O-B pintypes, plus the element of quick, safe handling. This isn't the only good point in O-B Clamptops. There are others such as highest possible slip strength and the highest level of radio-proofness.

Investigate O-B Clamptops for your construction or replacement programs.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

HI-TENSION NEWS *Junior*



SOMETHING *NEW* IN POWER TRANSMISSION

. . . SOMETHING YOU SHOULDN'T MISS!

There is a surprise in store for you if you could visit the O-B High-Voltage Laboratory. Here, O-B Cooline clamps have been under exhaustive high-current test. You could lay your hand on a cable, almost too hot to bear, and only a few inches away, a Cooline clamp that is scarcely warm! The clamp is contributing nothing to the heating effect, and its high heat-conductivity plus its greater radiating surface keeps it many degrees below cable temperature.

But the real story is found in the dollars this represents. Because Cooline clamps don't heat, they don't consume the kilowatts necessary to produce this heat. Furthermore, the high capital investment once wasted in producing these dissipated kilowatts is now utilized at a profit, since this power may now reach the meter and thus become "salable merchandise."

On lines operating above 200 amperes, where heat-loss is most serious, Cooline clamps will save their entire cost in possibly the first three to five years. And in each such period of time thereafter, they will hand back a similar amount of money in the form of a clear saving. All this time, thousands of dollars in invested capital will be put to work earning its normal profit.

Look into the economics of O-B Cooline clamps. This is something new in power transmission—something you shouldn't miss!

Yes, you can prove the soundness of an insulator

DO YOU EVER WONDER how much life remains in a suspension insulator after a long service period? One power company recently did. They returned 30 O-B units, selected entirely at random, from a line 22 years old and asked for a test report. Standard AIEE and ASA tests were performed, including regular routine factory proof tests, as applied to new insulators.

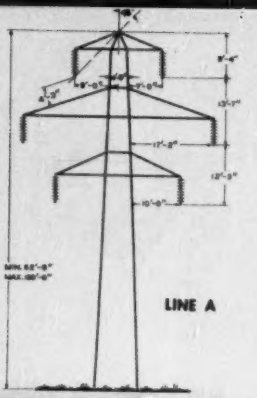
Every insulator passed! They received O-B's regular three-minute, 60-cycle flashover given every new unit in the factory. They were given the double thermal test; ten cycles of quick change from 150 to 39 degrees F., followed by another ten from 205 to 39 degrees. They were subjected to a combined mechanical and electrical test, where all failures were simultaneous with normal porcelain fracture. Not one broke below catalog rating, nor was there an abnormally strong unit which is equally important as an indication of good manufacturing control. This entire group of insulators was as good as that day's production in the O-B plant, yet they had seen 22 years of service on the line.

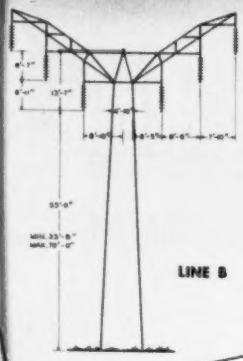
We, or no one else, can prove a thing like this when we are showing you a *new* insulator. It takes time to bring out O-B's soundness. But it's there, and it *is* subject to proof, eventually. And, if you want to install suspension insulators that will be just as good a generation from now as they are today, build with O-B—and then forget them!

Ohio Brass

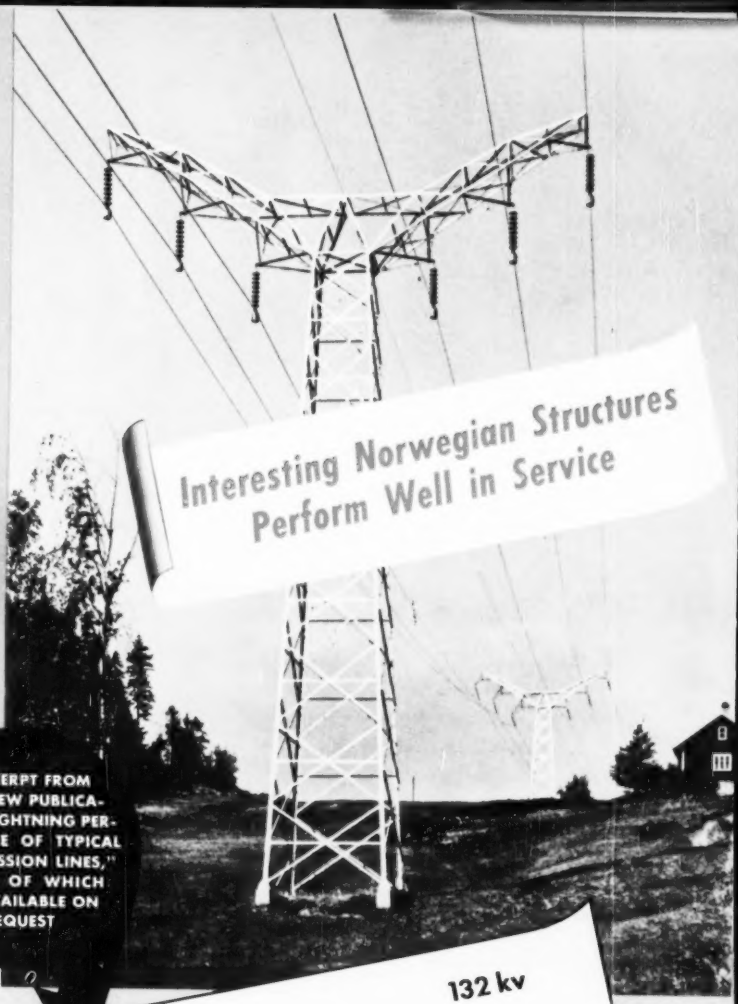
MANSFIELD, OHIO, U. S. A.

HI-TENSION NEWS *Junior*





Interesting Norwegian Structures Perform Well in Service



AN EXERPT FROM O-B'S NEW PUBLICATION, "LIGHTNING PERFORMANCE OF TYPICAL TRANSMISSION LINES," COPIES OF WHICH ARE AVAILABLE ON REQUEST

Norges Vassdrags - Og Elektrisitetsvesen

132 kv

LOCATION OF LINE: Oslo, Norway
(A) Nore Kraftverk to Flesaker Substation
(B) Flesaker Substation to Slagen Substation

VOLTAGE: 132 kv (50 cycles)

LENGTH:
(A) 51 miles
(B) 37 miles

YEARS OF OPERATION: 19

GENERAL DIRECTION: North-South

AVERAGE TERRAIN: Rolling timber land

ANNUAL STORM DAYS: 8 (Total storm days for the entire line are not known and the figure shown is an estimate based on records which do not readily lend themselves to interpretation according to the U. S. Weather Bureau Standard. The indicated figure is probably on the conservative side)

CONDUCTOR:
(A) 300,000 cir mils, 26-7 ACSR
(B) 3/0 ACSR

OVERHEAD GROUND WIRE: 86,000 cir mils, galvanized steel

MID-SPAN SEPARATION, GROUND WIRE TO CONDUCTOR:
(A) 13 feet, 2 inches
(B) 16 feet, 4 inches

SUSPENSION INSULATORS: Tangent, 8 (11 x 6¾). Angle and deadend, 9 (11 x 6¾)

NORMAL TANGENT SPAN LENGTH:
(A) 870 feet
(B) 750 feet

ARCING HORNS OR RINGS: Horns

TOWER FOOTING RESISTANCE: Average 200 ohms

COUNTERPOISE: Copper plate 39 inches x 19½ inches x ½-inch

IMPULSE INSULATION: 950 kv, 1½x40 mu-s, positive critical

NORMAL TOTAL TIME TO CLEAR GROUND FAULT: 1 sec (50 cycles)

GROUND FAULT NEUTRALIZER OR PROTECTOR TUBES: Petersen coils

ARC DAMAGE TO INSULATORS OR CONDUCTORS: Yes. In one instance all porcelain was stripped from a strain insulator string, but the string did not fail mechanically

AVERAGE ANNUAL LIGHTNING OUTAGES: 2 for combined lines (88 miles)

AVERAGE ANNUAL LIGHTNING OUTAGES PER 100 MILES: 2.3 (combined lines)

Ohio Brass
MANSFIELD, OHIO, U.S.A.

2974-H

(not necessarily along the pole) at a pressure of 115 kv per ft. Many companies paint and letter red bands on the sticks according to the various voltages on their system. A safety pole rubber hand guard can then be adjusted to the proper band for the voltage being worked. The following distances do not refer to the overall length of the insulated stick, but refer to the minimum distance between the live line part of the tool and the safety pole rubber hand guard beyond which the lineman should not reach:

KV	*Minimum Insulation*
7—7.9	1 ft
13.2—33	2 ft
44—66	3 ft
110—132	5 ft
154—176	7 ft
196—220	9 ft

A good precaution is to check creepage due to atmospheric conditions by first putting butt of tool against pole or some convenient ground and laying the head over conductor then removing butt of tool from ground and feeling up the pole with bare hands to detect "fuzzy feeling", thus determining if tools can be handled at recommended distance from conductor.

13. Where distribution primaries are on "high line" poles, they should be covered with rubber protective equipment before climbing through or working above them.

14. If a line conductor is small, bear in mind that it might break and work accordingly.

15. While working lines "hot" a man should not change his position on a pole without first looking around and informing the other men what he is going to do.

16. Under no circumstances depend upon a man to hold a live line clear of linemen working on the pole.

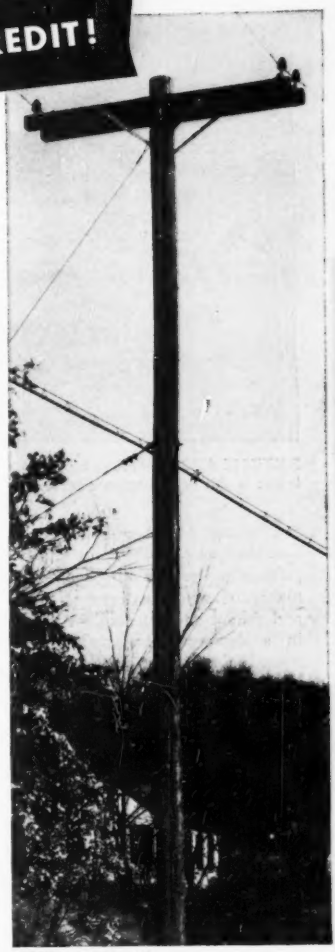
17. When moving a live wire, stay below the wire until it is thoroughly secured in a safe working position.

18. In changing out pin type insulators, keep the tie wires rolled into a ball or cut them off short as they are unwound so that they will never be long enough to reach a ground or endanger a lineman.

19. Do not use ropes on conductors carrying more than 5 kv unless rope is insulated from the conductor with a link stick.

CASE HISTORY
confirms 30-year service life for treated poles

...AND CREOSOTE GETS THE CREDIT!



HERE's a convincing case history* concerning 71 pressure-creosoted pine poles—part of an electric power transmission line erected in Kansas in 1917.

In 1947, after 30 years in line, 68 out of 71 poles were still sound and serviceable—furthermore, the inspection revealed that these poles appeared to be capable of service for some time to come. Of the remaining 3 poles, 2 had been removed because of line changes—1 had been damaged by lightning.

Of the original 71 poles, *not a single one had been removed because of decay*—a splendid testimonial to creosote. And all the more noteworthy when you consider that the preservative treatment used to protect these poles was somewhat lighter than is now regarded as good practice.

Creosote is the performance-proved, time-tested preservative for poles and crossarms. And for the best possible creosote delivery service, get in touch with the nation's largest distributor—Koppers. With 14 creosote-producing plants—with 4 large storage plants—Koppers can always meet your creosote requirements.

KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.

*Wood Preserving News—1947

All Standard Specifications
For All Types of Wood Preservation

KOPPERS CREOSOTE... *to be sure!*

LOAD BUILDING

Working Together Provides Demonstration Classroom

FIXTURES AND LAMPS, wiring and installation, paint and painting, light-colored chalkboards in this demonstration classroom were all donated by interested concerns

COOPERATION of fixture and lamp manufacturers, wiring contractor, paint supplier, painting contractor, maker of school equipment, utility, and school officials resulted last fall in a demonstration modern classroom in the Eisenhower High School, Norristown, Pa. Since then, and resulting from it, plans are now in hand for the modernizing of several hundred classrooms in the immediate area.

Development of Idea

The idea developed from the attendance at a Nela Park School Executives Conference of Abram S. Kulp, Montgomery County superintendent of schools. Mr. Kulp was so impressed that he said to his host, Frank Schirmer, Philadelphia Electric Co, that he wished his School Directors Association could be told or shown what he had learned from the Nela Park demonstrations and lectures. As the idea took shape, it grew into a plan for a demonstration classroom to be unveiled at the fall meeting of the Association.

The plan was put up to the fixture maker members of the Electrical Association of Philadelphia. Offers to supply the fixtures came from eight of them—Kurt Versen Co, Sylvania Electric Products, Leader Electric Co, Gill Glass & Fixtures Co, Curtis Lighting, Day-Brite Lighting, Keystone Electric Co, and F. W. Wakefield Brass Co. Since only one make of fixture would be used, one name —Day-Brite Lighting—was drawn from a hat. This company supplied 18 2-lamp, 40-w semi-direct fixtures with shielded sides and egg-crate louver bottoms.

Other Equipment

Lamps were furnished by three manufacturers — General Electric, Westinghouse and Sylvania. The fixtures were installed by William S. Mussulman. Paint was supplied by Monroe, Lederer & Taussigs, Inc, and applied by John S. Fehr, painting contractor. Chatfield Clark chalkboards were installed by C. F. Bond, local representative. The Norristown School District made a classroom available, and Philadelphia Electric made itself useful when and where it could in the project.

Thus, when the School Directors Association of Montgomery County assembled for their 114th meeting, they found ready for their inspection an up-to-the-minute classroom, modern in every respect of lighting, color and equipment. They heard a lecture on "Education—an Investment in People", by John T. Soltman, U. S. Chamber of Commerce, after which Charles C. Shotwell, Philadelphia Electric, described and demonstrated how lighting and other factors of classroom environment affect pupils and their facility in learning.

Room Used Over and Over

Total attendance at the meeting was 303, made up of 193 members of the Association and 110 visitors, representatives of local Chambers of Commerce and of school groups outside Montgomery County. Since the meeting, the room has been used many times for demonstrations to interested groups.

Radiant Heat Keeps Food At Serving Temperature

RADIANT HEATERS keep food hot on the counter but do not overheat the plates

BY THE INSTALLATION of two radiant heaters, food is kept hot on the serving counter of The Golden Star Dairyland, a restaurant in East Liver-

Anaconda continues its "Wire Ahead" Campaign to your industrial customers. They are reading this ad now.

How Big is the CORE of your POWER apple?

Densheath Type TW Building Wire with its special thermoplastic insulation is sound production insurance in any plant. It will not support combustion, is long-aging, impervious to acids, oils and alkalis. It is recognized by the National Electrical Code for circuits up to 600 volts and temperatures up to 140° F.... and for wet and oily locations. Being light weight, with a smooth, slick finish and without braid, Densheath pulls through easier . . . resists abrasion. Permanent, bright colors for quick circuit identification. Write for literature.

This is important, too—*for rewiring in existing raceways*, the Code recognizes the smaller diameter of Densheath TW and permits more conductors to be pulled in the same size conduit. Here is a typical case—

½" CONDUIT

Type R	Type TW
3 #10 Wires	6 #10 Wires

HOW MUCH of the electric power you pay for do you *throw over your shoulder* through overloaded, overextended, obsolete, inadequate wiring?*

Avoid wasting power. Find present losses and safeguard future expansion. Talk to your plant power engineer, consulting engineer, electrical contractor, wholesaler or utility power salesman. It's their job to advise and protect you against slow-downs and shut-downs that mean unproductive wages, lost production, spoilage.

***WIRE AHEAD** . . . a comprehensive discussion of preventive maintenance, points out the symptoms of inadequate wiring, presents detailed plans for anticipating electrical demand. Forty-eight factual pages of practical information and suggestions free on request.

ANACONDA
from mine to consumer

ANACONDA WIRE & CABLE COMPANY
25 Broadway, New York 4, N. Y.

pool, Ohio. The serving counter is at one end of a dining room approximately 100 ft long.

Cooled Before Pick-up

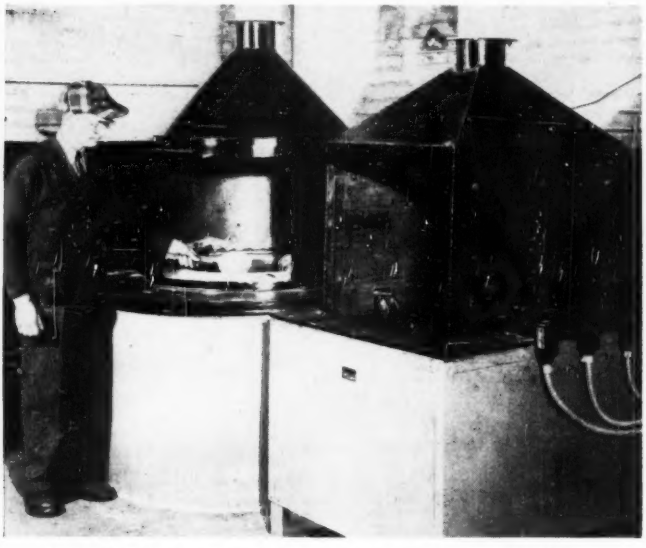
The problem at this restaurant was to keep food at proper serving temperature just before pick-up. During rush hours pick-up is sometimes delayed while waitresses are writing orders.

Solution was the installation of two 300-w heaters mounted in line and attached with small angle irons and studs to the serving counter "roof". Each glassless heater has a tubular element and a protective grill. The infrared heat rays are radiated directly on the food and the heating job is performed without any objectionable glare. Each heater has an overall length of 24¾ in., and the heated length is 17 in. Distance from the serving counter to the bottom of the parabolic aluminum reflector is 11 in.

The two heaters are operated continuously from 8 AM to midnight except for approximately one hour in the afternoon.

More Meals Served

As a result, food is served hot on the table and plates remain at comfortable handling temperature. The management has reported that customer complaints from cold food are eliminated. In addition the heater installation has contributed to more efficient cooking and serving, and permits serving more meals during rush hours.



IMMERSION (right) and exteriorly (left) heated pots for melting tin and babbit

Electric Babbit Heating Eliminates Bearing Rejects

J. S. RUGGLES
New York Power & Light Light Co
Albany, N. Y.

EXPERIENCE with electrically heated melting pots in the production of journal bearings in the Magnus Metal Division of the National Lead Co has resulted in the adoption of electric melting of babbit and tin in six other plants of the company. Exact control of metal temperature, with consequent practical elimination of rejected bearings, was the reason.

In the Magnus Metal plant at Albany, N. Y. are three tin and three babbit pots. The tin pots are heated with cast-in immersion heaters, totalling 30 to 40 kw and holding the metal to temperatures up to a maximum of 950 F as may be required.

High Operating Temperature

Babbit pots are heated with ribbon resistor elements outside the crucibles. This is because their operating temperatures are around 1,150 F, higher than normally practicable for immersion heaters. The rating of these pots is 38 kw.

TV Interviews Aid Industrial Development

IDENTIFICATION with the interest of the community it serves appears as a main purpose of the Consolidated Gas Electric Light & Power Co of Baltimore in a booklet recently published by the company. The booklet, 44 pages in stiff paper cover, titled, "Industry Looks At Baltimore's Opportunities", consists of transcripts of 13 Wednesday evening television interviews over station WBAL-TV last fall and winter. After television presentation, each interview was re-broadcast by radio the next Sunday afternoon.

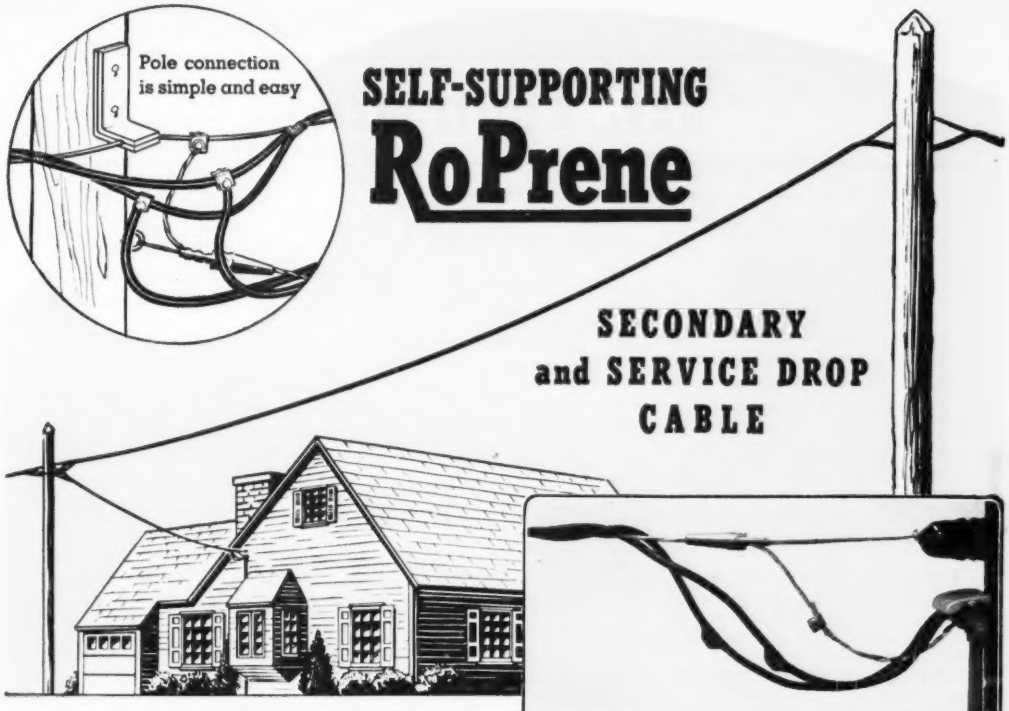
Kickoff Interview

Introducing the series was an interview with the executive vice-president of the power company who said, "Our company is sponsoring this series so that it may fulfill one of its duties as a citizen of the community. . . . By showing what opportunities Baltimore offers industry—opportunities for successful operation and stable growth—other business organizations may become interested in locating here. Our company, in the future as in the past, will put its chief reliance for growth and development on the planned development of the city." The following 12 interviews with industrial leaders told of the advantages their respective companies enjoyed by their location in Baltimore.

The interview transcripts, illustrated with pictures of the interviewers and of their plants, make an effective publicity piece, useful in public relations and industrial development activities.

SELF-SUPPORTING RoPrene

SECONDARY and SERVICE DROP CABLE



Service drop connection to house simplified with fittings and hardware commercially available.

Photo courtesy Fargo Mfg. Co., Inc.

FOR ECONOMY IN AERIAL SERVICE

As a new development of time-proven construction, RoPrene Secondary or Service Drop Cable consists of RoPrene (Neoprene) insulated power conductors, spiralled around a "straight-away" neutral conductor for mechanical support. Here is simplicity in construction, economy of installation, longer life under all weather conditions . . . plus the neater appearance of a single cable assembly compared to open wires.

These advantages can be yours:

- **Lower Cost**
- **Ease and Economy of Installation**
- **No Mechanical Stress on Power Conductors**
- **No Coverings to Rot and Festoon**
- **High Weather Resistance**
- **Reduced Maintenance**
- **Neat, Compact Appearance**
- **Versatility**

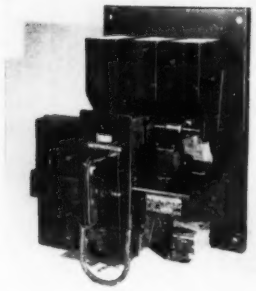
Write for more information and specification RS-4. See for yourself why, more and more, RoPrene Secondary and Service Drop Cable is becoming the accepted cable for overhead services. Available in a wide range of types and sizes.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

ROME • NEW YORK

NEW EQUIPMENT



Circuit Breakers

FOR LOW-VOLTAGE power distribution in industrial plants and motor starting duty, Type DB circuit breakers with extremely accurate tripping characteristics are announced by Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa.

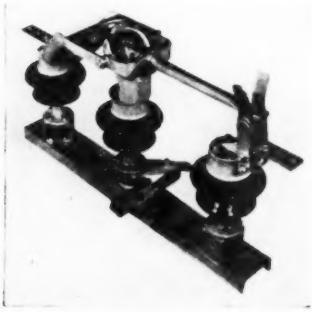
They are available for overcurrent protection with delayed and instantaneous tripping for motor or general use, or for overcurrent protection with long and short delay for proper coordination in selective protection on fault current.

The DB-15 has an interrupting rating of 15,000 amp with load current ratings up to 225 amp at 600 v a-c or 250 v d-c. The DB-25 handles load currents up to 600 amp with interrupting rating of 25,000 amp.

•

Airbreak Switches

A COMPLETE LINE of airbreak switches of the vertical break type with ratings from 600 to 1,200 amp at 7.5 to 230 kv has been announced by Powercraft Corp, 2215 De Kalb St, St. Louis 4, Mo.

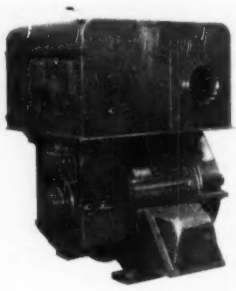


Reported design features are: Silver alloy to silver alloy contacts throughout; all current carrying members made of bus bar copper; and anti-friction bearings which are permanently lubricated. The company states the units have a generous factor of safety and have exceptional operational ease.

•

Unit-Cooled D-C Motors

SLOW SPEED OPERATION for long periods is possible with standard, totally enclosed, unit-cooled, d-c motors now equipped with a new type cooling assembly. Motor and cooler unit are available in ratings up to 200 hp from



General Electric Co's Large Motor and Generator Divisions, Schenectady 5, N. Y.

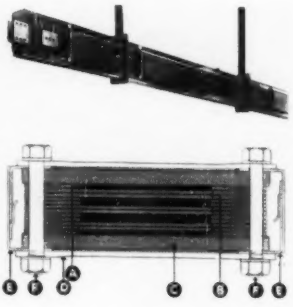
Two blowers, driven by one induction motor, provide ventilation in the air-to-air cooling assembly which is independent of main motor speed. These unit-cooled motors are designed for operation in dusty, dirty and oil-laden atmospheres and require no duct-work, air filter or pressurized air supply.

•

One-Split Bus

FOR REDUCED VOLTAGE DROP in the distribution of power over long buses, a "one-split bus" arrangement has been incorporated into a feed-in duct assembly by Square D Co, 6060 Rivard St, Detroit 11, Mich.

Illustrated above right is a 3-ph feed-in duct cross section. "One-split



bus" (A), with halves on either side of the other two buses separated by insulator plates, permits close spacing and electrical symmetry. Solid ebonized asbestos insulating plates (B and C) totally enclose the buses. They are impervious to moisture and resistant to arcing. Surge clamps (D) and bolts (F) every 2 ft add structural and mechanical strength to withstand 50,000-amp "shorts". Steel channels (E) complete the housing.

Feed-in duct is available in 1,200, 1,600, 2,000, 3,000 and 4,000-amp ratings, 2 and 3-w 1-ph service; 3-ph and 4-w service for 600 v or less. The assembly carries UL approval.

•

Gasketing Tape

SERVING PRIMARILY as a protective seal against the elements, a zinc-chromate-impregnated gasketing material called Chrome Lock has properties that make it suitable for possible use in sealing transformer covers, junction boxes, potheads, etc. It is made by Products Research Co, 5426 San Fernando Rd, Glendale, Calif.

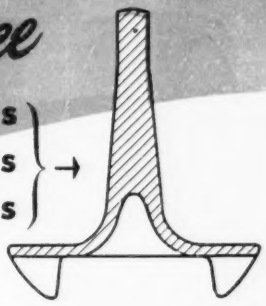
Chrome Lock's properties are reported to include: Indefinite pliability and resistance to permanent distortion, definite corrosion resistance, and electrolysis prevention between dissimilar metals. Other properties are non-oxidizing, non-toxic and complete resistance to water and saline solutions. It is provided with a pressure sensitive adhesive for application to all-position surfaces.

Material is claimed to withstand dry heat temperatures up to about 200 F, with a tendency to extrude at 145 F in the proximity of hot water under pres-

HUBBARD FORGED STEEL CORNER PINS

One Piece

. . . no seams
. . . no joints
. . . no welds



Hubbard Drop Forged Corner Pins are made from a single piece of steel, forged to a broad base which completely covers the top of the arm. There are no seams, joints or pockets to retain moisture and hasten corrosion.

Due to the one piece construction, maximum strength is retained for the weight of metal used, and radio interference is minimized. Structural strength is also enhanced by the method of attachment, as the strap illustrated binds the wood fibres of the arm in such a way as to prevent splitting.

Hubbard and Company was the first to place this style pin on the market and it has been a popular choice for over twenty-two years. Furnished also with carriage bolts and a separate bottom strap to meet R.E.A. specifications.

HUBBARD AND COMPANY

PITTSBURGH
CHICAGO

OAKLAND
CALIFORNIA

ILLINOIS HAS Everything
YOU WANT IN EQUIPMENT PORCELAINS...

HIGH DIELECTRIC STRENGTH

HIGH MECHANICAL STRENGTH

COMPLETE UNIFORMITY AND EXACT DIMENSIONS

These are the *plus* qualities you get with every piece of Equipment Porcelain made by Illinois! The whole process of manufacturing electrical porcelain is characterized by extreme care, not only in controlling the chemical composition of ingredients, but the particle size, moisture content, and the drying and firing temperature.

ILLINOIS ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

sure. It is available in tapes in four thicknesses from 1/32 to ¼ in., in any width from 3/16 to 72 in. Also available are sheets or stampings to meet individual needs.

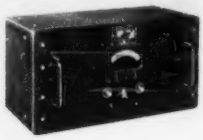
•

Rotating Gin

TRANSFORMERS and other heavy objects can be hoisted to the pole top by means of a rotating gin made by A. B. Chance Co, Centralia, Mo.

A folding, 15-in. steel arm and rotating action of the laminated maple mast pole assure easy clearance of crossarms and conductors. Two chain tighteners permit the gin to be fastened to poles from 6 to 11 in. in diam. Four gigs (two on each chain tightener) bite into the pole to prevent gin movement around the pole.

•



Voltage Regulator

WITH a response speed said to be higher than heretofor obtainable in automatic voltage regulators of comparable characteristics, a small automatic voltage regulator has been announced by Superior Electric Co, 24 Hannon Ave, Bristol, Conn. The manufacturer states that only 3 sec are required to correct for the wide line voltage excursion of 95–135 v.

Listed as Stabiline Type EM 4102, the regulator is electromechanical in operation, consisting of a variable transformer controlled by a specially designed electronic detector. Ratings of this unit are: Input, 95–135 v; output, adjustable between 110 and 120 v, 20.0 amp, 0–2 kva; input frequency, 50–60 cycles. It is reported to be completely insensitive to load power factor.

This regulator is offered as a cabinet-contained or rack-mounting unit.

•

Combination Meter

FOR POWER COMPANIES having rate structures requiring the measurement of kva demand, a combination watthour and thermal kva demand meter has been announced by General Electric Co's Meter and Instrument Divisions, Schenectady 5, N. Y. Type IHE-1A meter takes the same mounting as a

It's This Heavy Duty Spring

That Makes the Big Difference in FARGO AGE SERIES HOT LINE CLAMPS!

AND HERE'S WHY:

It's this heavy duty spring that makes up for the variables caused by fault currents . . . atmospheric changes . . . load variations—and the tendency of the conductor to "relax" or "flow" while under stress.

Again, it's this heavy duty spring that compensates for the different torque linemen use in tightening connections.

Last—but by no means least—it's this heavy duty spring that makes the Fargo AGE Series Hot Line Clamps vibration-proof!

You'll discover, too, that Fargo AGE Series Hot Line Clamps have contact area enough to avoid heating as a result of fault currents—yet, they're light enough to be easily and quickly installed at the end of a stick.

Like other products bearing the Fargo name, the AGE Series Hot Line Clamps are built of the finest materials to meet the exacting requirements of Utility operations and give the maximum in performance.

CLAMPS NOW AVAILABLE IN 3 SIZES

		RUN WIRE (Copper)		TAP WIRE (Copper)	
		Max.	Min.	Max.	Min.
All-Purpose Cast Bronze (plated)	AGE–0	#2 Str. Cu.	#8 Sol. Cu.	#2 Str. Cu.	#8 Sol. Cu.
	AGE–1	250,000 CM Cu.	#6 Sol. Cu.	#2/0 Str. Cu.	#6 Sol. Cu.
	AGE–2	750,000 CM Cu	#4/0 Str. Cu.	250,000 CM Cu.	#6 Sol. Cu.
		RUN WIRE (Aluminum)		TAP WIRE (Aluminum)	
		Max.	Min.	Max.	Min.
Cast Aluminum	AGE–0A	#2ACSR	#8 Sol. Alum.	#2ACSR	#8 Sol. Alum.
	AGE–1A	250,000 CM Alum.	#6 Sol. Alum.	#2/0 Str. Alum.	#6 Sol. Alum.
	AGE–2A	750,000 CM Alum.	#4/0 Str. Alum.	250,000 CM Alum.	#6 Sol. Alum.

Note: AGE Series Hot Line Clamps are also available for Aluminum-to-Copper Connections.

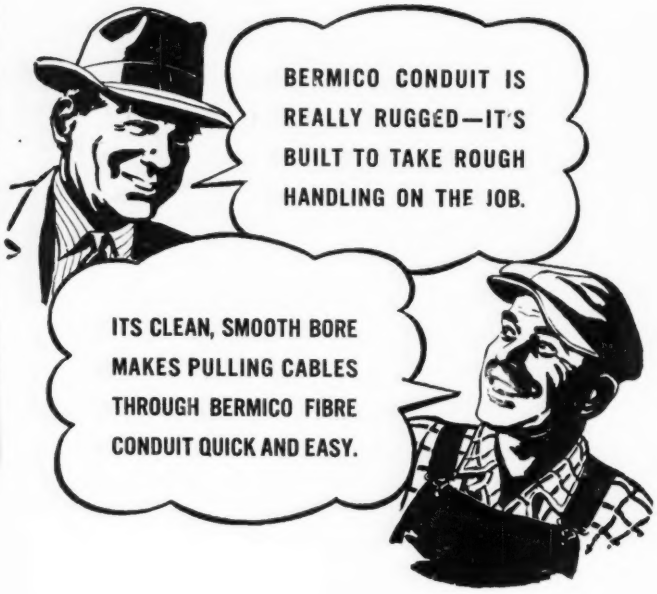
FARGO

Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N. Y.

LM

BERMICO* FIBRE CONDUIT


BERMICO CONDUIT IS REALLY RUGGED—IT'S BUILT TO TAKE ROUGH HANDLING ON THE JOB.
ITS CLEAN, SMOOTH BORE MAKES PULLING CABLES THROUGH BERMICO FIBRE CONDUIT QUICK AND EASY.

distributed by
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
Offices in all leading cities

BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY

conventional watthour meter. It is available in the 50-amp, 240-v, 3-w, 1-ph rating.

The watthour meter is the same as the I-50 meter, but with a rotating element of the ball-bearing type. Thermal demand meter unit consists of the thermal unit, a current transformer, a resistance valve and a potential transformer for exciting the heater of the resistance valve. Further information is contained in Bulletin GEC-504.

•

Annunciator

TO INDICATE the occurrence, continuance or termination of any process or operation by sight and sound, the ANFA annunciator has been developed by The Autocall Co, Shelby, Ohio, for use in industrial plants and power companies.

Three switches are required by this unit. One illuminates all lamps to test for burned-out bulbs, while the second

turns off the remote bell or horn which announces the illumination of a window. The third switch extinguishes any energized lamp by resetting the relay control. This control keeps a window illuminated until it is reset, even after the actuating switch has reopened.

Annunciators are also adaptable to serve as a communication system between remote points, with pushbutton actuation.

•

Circuit Breaker

AVAILABLE as either a circuit breaker or circuit interrupter of high interrupting capacity, a compact industrial circuit breaker has been announced by Square D Co, 6060 Rivard St, Detroit 11, Mich. It is Type ML-1.

Built into this unit is a thermal-magnetic (coilless) tripping mechanism. Thermal element hold momentary overloads but trips out on continuous

Uptegraff type WA Specialty Transformer with ventilated weatherproof enclosure, for indoor or outdoor service. Sizes, 15 to 100 KVA.

Dry Type TRANSFORMERS

The built-in dependability and economy of Uptegraff Dry Type Transformers comes from engineering and manufacturing skill and experience. Available in standard types and sizes for immediate delivery, and promptly made in special styles to meet individual specifications when required by the application.

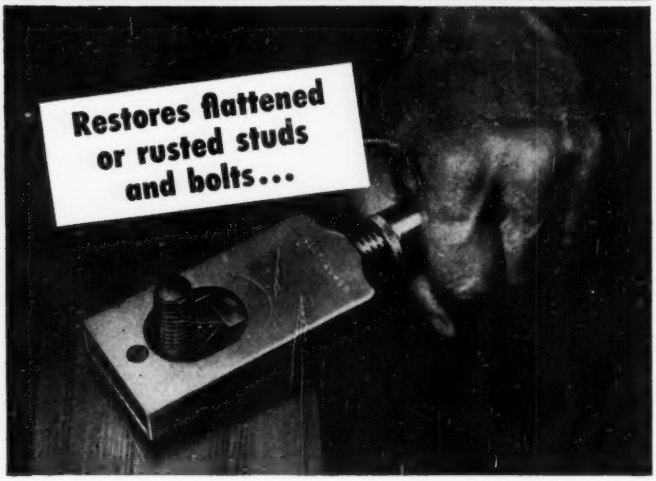
Some of the more popular Uptegraff Dry Type Transformers are illustrated here. Write for complete data and prices, giving capacity required and service for which the transformer is intended.

R. E. UPTEGRAFF
MANUFACTURING COMPANY
SCOTTDALE, PENNSYLVANIA
Makers of POWER · DISTRIBUTION · INSTRUMENT · SPECIALTY Transformers

Type F dry type transformer, for protected cabinet mounting, or indoor service. Standard sizes, 0.1 to 10 KVA. Can be built in larger sizes.

Completely enclosed type E Uptegraff Transformer. Available in sizes from 0.1 to 10 KVA, for indoor service. All Uptegraff transformers are built and tested in accordance with the applicable standards of the N.E.M.A., the A.S.A., and the A.I.E.E.

BUCKINGHAM THREAD CLEANER



NOW — remove rust and recondition damaged threads this fast, simple way. A few quick twists of the Buckingham Thread Cleaner and presto! — the threads are slick and clean. Flats are smoothed-out . . . Nuts spin on and off in a jiffy.

This versatile thread cleaner saves time on field work, too. There's no need to remove a damaged stud . . . no hacksawing or drilling . . . no re-tapping of the hole. Simply slip the tool over the mutilated stud or bolt, tighten the cutting jaws and twist. That's all!

Buckingham Thread Cleaners follow the pitch of any right- or left-hand thread with a root diameter from ¼" to 2 9/16". Separate thread cutting dies are not required — the adjustable cutting jaws of the Cleaner are easily set to the proper size . . . *on the bolt*. Once adjusted, the setting is maintained by the single lock nut on the knurled handle.

Buckingham Thread Cleaners are available in two sizes:

No. 6103 ¼" to 1" root diameter; Weight, 15 Oz.; Price $6.50

No. 6104 1" to 2 5/16" root diameter; Weight, 2 lbs.; Price $13.00

BUCKINGHAM equipment is sold by over 800 authorized dealers. See the Buckingham Thread Cleaner at the dealer nearest you, or write today for additional information on this versatile, time-saving tool.

BUCKINGHAM MANUFACTURING CO., INC.
5-7 Travis Street Binghamton, N. Y.

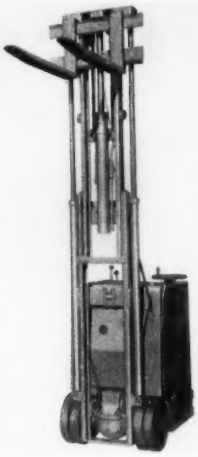
overloads. Magnetic element trips out on shorts to localize damage.

Type ML-1 breaker inclosures include dust-resisting, rain-tight, weatherproof and dust-tight, and explosion-resisting styles. Ratings are 15 to 50 amp at 600 v a-c or 250 v d-c, or 70 to 100 amp at 250 v a-c or 125/250 v d-c.

•

Electric Fork Truck

DESIGNED for operation in warehouses and plants with narrow aisles, an improved 2,000-lb capacity electric fork truck, Model JHVH-2H, is manufactured by Crescent Truck Co, Lebanon, Pa. It is reported to be the only



2,000-lb capacity truck that will right-angle stack from 8-ft aisles with a 40x 32-in. pallet.

Free initial lift is 63½ in., with a max lift of 120 in. Collapsed height of 83 in. overall permits operation under low head room. Standard tilt is 5 deg back and 3 deg forward.

•

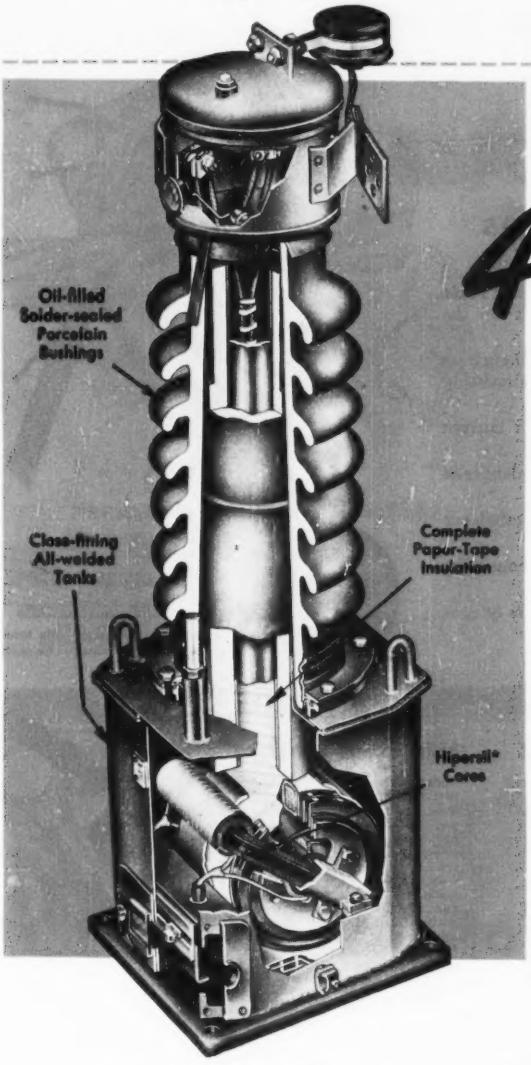
Sheathed Cable

STRIPPING TIME is cut 80% with an improved non-metallic sheathed cable, according to the manufacturer, Triangle Conduit & Cable Co, Inc, 1900 Jersey Ave, New Brunswick, N. J. "Triex" construction eliminates the individual wrapping over each wire, and instead of 2/64-in. rubber insulation on sizes No. 14 and 12, 4/64-in. layer of rubber is applied to tinned copper conductors.

The "Glazon" outer covering utilizes an inorganic glass derivative which cannot burn, rot or corrode, and is not affected by moisture or sunlight. This sheathed cable is UL listed for 600-v

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



This cutaway view shows the compact, sturdy construction of Type OCT. Both OPT and OCT transformers offer all four benefits.
*Trademark Reg. U. S. Pat. Off.

4 Reasons Why

(THEY'RE SMALLER)

Westinghouse Outdoor Instrument Transformers, the most complete line in the industry, are smaller because of:

1. **Hipersil cores**
2. **Oil-filled solder-sealed porcelain bushings**
3. **Complete paper-tape insulation**
4. **Close-fitting all-welded tanks**

Vacuum drying and impregnation assure reliability. Maintenance amounts to scarcely more than keeping the transformers wiped clean. A transparent window makes terminal inspection easy.

Typical outdoor Westinghouse instrument transformers are:

★ **Outdoor potential transformer, OPT:** Primary voltage range—24,000-69,000; frequency—50-60 cps; winding ratio 200:1 to 600:1; available in one or two H.V. bushing types.

★ **Outdoor current transformer, OCT:** Primary voltage range—24,000-69,000; ampere rating range—10-20/5 to 400-800/5.

Get the facts, *today*, about these space-saving, trouble-free instrument transformers. Call your local Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-70536

Westinghouse

TRANSFORMERS

for better Hot Tapping...

CHANCE *Hot Tap Clamps*

PROTECTED THREAD CLAMPS

. . . make better line connections—are easier to install and remove — reduce conductor vibration fatigue. These features make them the most advanced design on the market:

1. TOP HOUSING protects working parts and encloses sealed thread chamber filled with a corrosion resisting compound.
2. LARGER CONTACT AREA insures better current distribution.
3. BELL MOUTH ENDS on contact jaws reduce danger of damage to conductor.
4. JUMPER TERMINAL—positioned to counterbalance eye screw and alleviate stress.
5. COILED LOCKING SPRING assures continuous tight contact.

Available in a complete range of sizes for all types of connections.

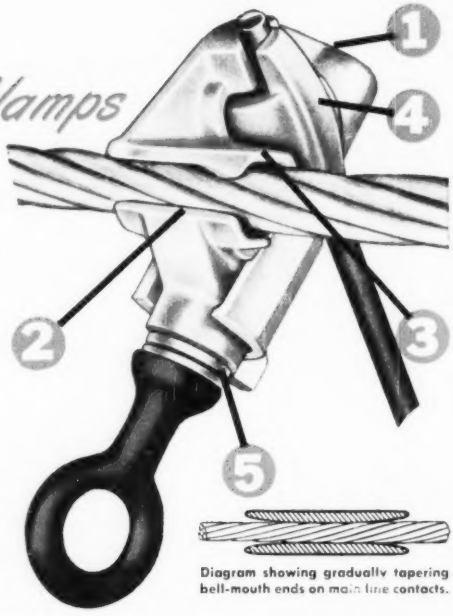


Diagram showing gradually tapering bell-mouth ends on main line contacts.

C496

FLIP-TAP CLAMPS

The Chance Flip-Tap Clamp features a lubrication cavity enclosing the threads on the eye screw. This grease chamber is filled with a corrosion resisting compound which prevents the clamp from sticking on the conductor.

The Flip-Tap Clamp is applied to the line with a quick snap effect and is tightened by turning the eye screw. Jaws of the clamp will take conductors ranging in size from No. 8 solid copper to 4/0 stranded copper.

PERMA-GRIP CLAMPS

Make permanent or temporary hot tap connections that hold tight without sticking and stay put without vibrating loose. U. S. S. threads screw up fast, hold tight . . . yet can be readily unscrewed with a clamp stick. They are made for tapping to aluminum, copper, or steel conductors and feature: High Current Capacity . . . High Mechanical Strength . . . Three Point Contact . . . Positive Pressure Jumper Connection. They are available in all types in a complete range of sizes to meet every requirement.

ABC INDUSTRIES

You know it's RIGHT

A. B. CHANCE COMPANY—CENTRALIA, MO.,

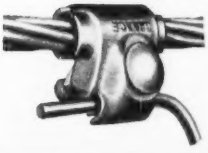
for Permanent Connections

CHANCE *Electrical Connectors*

U-BOLT CONNECTORS . . . Apply to Conductors without Removing Bolts.

An entirely new idea in U-Bolt Connectors—a swinging center spacer and base that eliminate the necessity of removing nuts and lock washers when applying to conductors. Can be applied or removed "hot". No annoyance of losing nuts or washers—application is quicker and easier. Chance U-Bolt Connectors simplify your inventory problems—only *three sizes* are needed for all conductors from No. 4 solid copper to 500,000 CM. Available for aluminum or copper conductors.

PARALLEL GROOVE CONNECTORS



Heat treated aluminum, galvanized contact copper, or all copper. Inexpensive, easily installed, lightweight connectors for use on line construction. All connector bodies plus galvanized bolts, nuts and lock washers are corrosion resistant. Available in a complete range of types and sizes.

SPLIT BOLT CONNECTORS

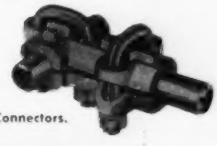
For temporary or permanent high-pressure solderless connections. They are designed for easy application in tight spots—large hex surfaces of the bolt and nut permit gripping from any angle with box, socket or open-end wrenches. Carefully beveled slot edges protect conductors from abrasion. Maximum contact is assured by V-groove construction.

Chance Power Connectors and Terminals

Designed to withstand high mechanical stresses, provide snug fit, and give long troublefree service.

Universal Terminals.

Stud Connectors.



Tee Connectors.

Cross Connectors.

Elbows.

Couplers.

These, and many other types of Connectors, Terminals, Bus Supports and Fittings are available in a wide range of sizes for tubing or cable.

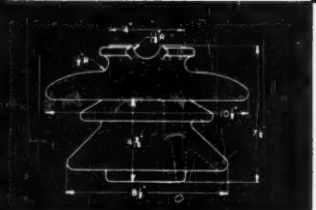
when you specify...

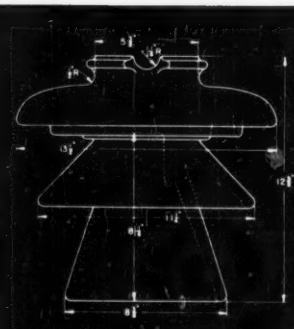
SAN FRANCISCO, CALIFORNIA

J-D

ONE PIECE AND MULTIPART HIGH VOLTAGE

Insulators





Write for Bulletin No. 500

JEFFERY-DEWITT INSULATOR CORP.

KENOVA, WEST VIRGINIA

U. S. A.

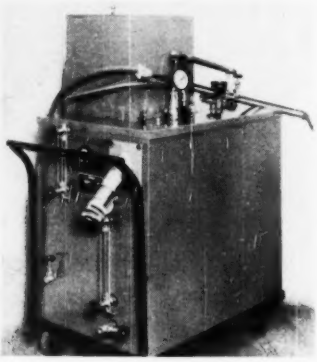
service. It is available with two or three conductors, solid or stranded, with or without ground wire, in sizes from No. 14 through No. 4.

•

Cleaning Unit

SAFE and efficient cleaning of windows, lighting fixtures and general factory equipment is assured through use of a steam-jet cleaner, the Speedylectric JC-30, manufactured by Livingstone Engineering Co, Dept JC-369, 100 Grove St, Worcester 5, Mass.

Features of this unit include: Mixing of steam and detergent at the jet;



pressure tank for positive flow of detergent; and constant fingertip control of boiler and jet. Minimum maintenance is required because of elimination of coils, tubes, pumps and motors.

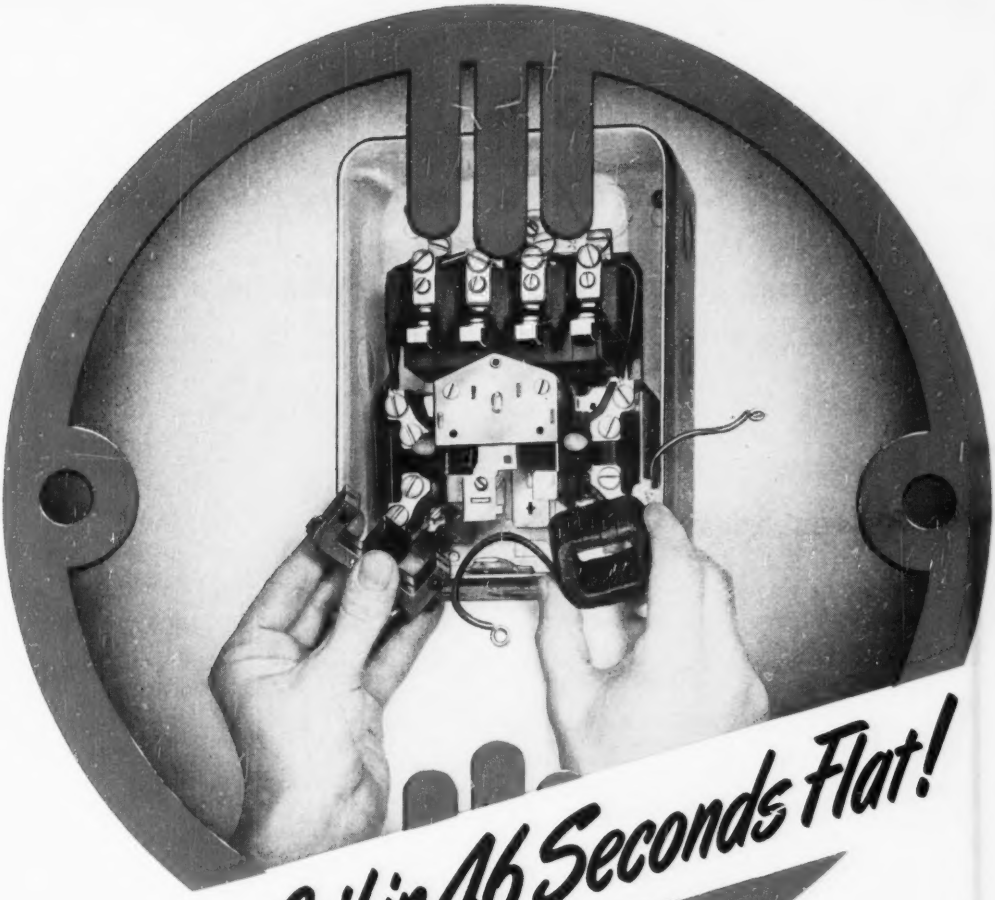
Equipment includes steam and detergent hose, nozzle and controls. Unit operates from 220 v and above, single or polyphase sources, with boiler rated at 30 kw. It is ASME National Board Stamped and has UL listing.

•

Multi-Lamp Fixture

FOR USE in offices and large and small stores, a 48-in. square, 9-in. deep, louvered fixture which mounts six, eight or ten 40-w fluorescent lamps is available from Day-Brite Lighting, Inc, 5411 Bulwer Ave, St. Louis 7, Mo. This unit can be used for both recessed and surface mounting applications.

Louver assembly consists of double wall interlocked louvers, equipped with separate hinging arrangement on two sides to permit hinging from two directions. Fixtures are rust-inhibited and finished in hot-bonded superwhite enamel. They are furnished wired and include sockets, No-Blink type starters, and high power factor, brick type ballast for 118-v, 60-cycle operation.



Change Coil in 46 Seconds Flat!

Change is FASTEST, EASIEST with Federal Noark Motor Starter

IT'S ALMOST "PRESTO, CHANGE!" replacing a coil in Federal Noark Motor Starters. Only three quick operations to get the old coil—three more, in reverse, to insert the new one. Federal design is the simplest, fastest on the market today. All parts readily accessible from the front. Saves time, effort and money.

What's more, there's almost no chance for trouble in Federal Noark Motor Starters. There's only one moving unit and that *rides on ball bearings*—an exclusive Federal feature!... Important, too, Federal permits the choice of getting automatic or manual reset instantly... simply turn a knob and you've the type of overload protection that you want.

Order Federal Noark Motor Starters from your Federal Distributor. And write us for free copies of the "Federalog" and "Simplified Motor Control" giving full descriptions. Federal Electric Products Company, 50 Paris St., Newark 5, New Jersey.

FEDERAL NOARK

MOTOR STARTERS

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Bus Duct ★ Sales offices in principal cities.

2,800,000 Lb Per Hr of Controlled Superheated Steam

Produced in One Station by Foster Wheeler Twin Furnace Steam Generators

Slag-free Operation

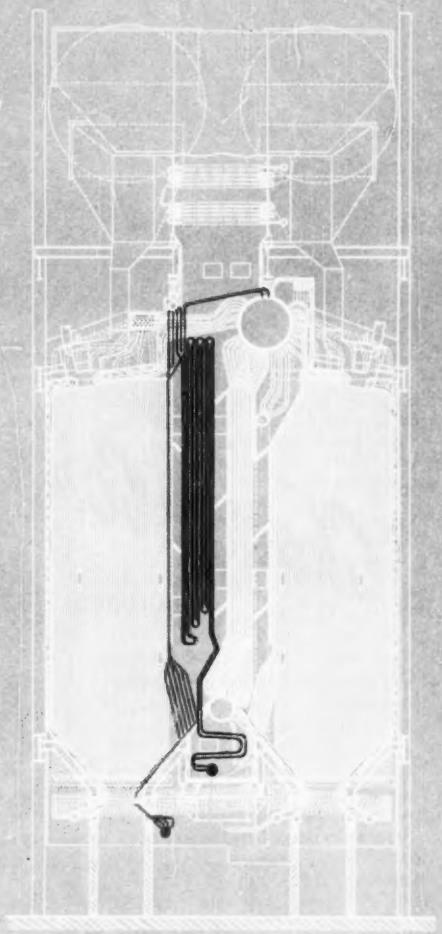
Furnace exit gas temperatures of high capacity, high pressure, high steam temperature units are established by the slagging characteristics of the fuel fired. The Twin Furnace design provides approximately 30% more cooling surface than a single furnace unit having similar furnace proportions.

Controlled Final Steam Temperature

By judicious proportioning of the surface of the radiant superheater located in one furnace and the convection superheater, a desirable flat characteristic steam temperature curve may be attained. Further control is obtainable by differentially firing the two furnaces thus stabilizing steam conditions for optimum turbine efficiency over the widest possible operating range.

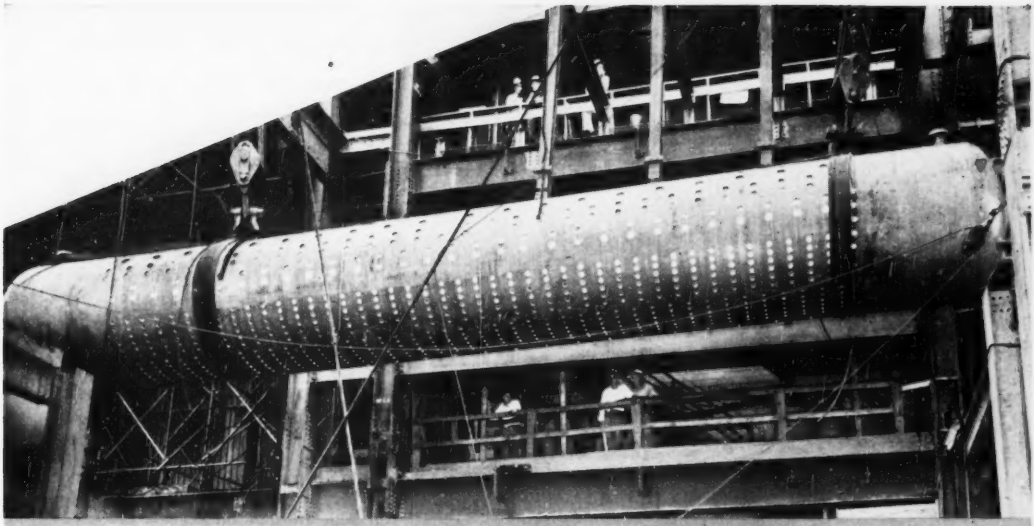
Compact Design

Substantial saving in building space is achieved through the use of smaller permissible furnace volumes with increased cooled wall area distributed in two furnaces and by compact arrangement of all component parts of the unit.

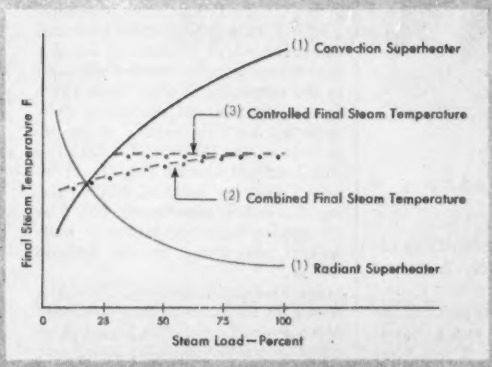


Duquesne Light Company
Phillips Power Station
Pittsburgh, Pennsylvania

Steam capacity	600,000 lb per hr
Superheat control range	270,000 to 600,000 lb per hr
Pressure superheater outlet	900 psi
Final steam temperature	900 F
Bituminous Coal Pulverized in FW Ball Mills	



An upper steam drum being placed in position at Unit No. 2 of the Phillips Power Station of the Duquesne Light Company.



Curves showing final steam temperature

(1) Convection and radiant superheaters operating independently

(2) Twin Furnace combination radiant and convection superheater

(3) Controlled differential firing at lower partial loads, minimizing the need for special temperature control equipment.

A total of 5 Twin Furnace steam generators—designed, engineered, and constructed by Foster Wheeler—will be installed at the Phillips Power Station of the Duquesne Light Company which serves a large area in and around Pittsburgh, Pa. Two are already in service and three are on the way. This station, which will generate 237,000 kilowatts when completed, is part of a system covering a territory populated by some 1,500,000 persons.

Growing preference for this ideally balanced design is evidenced by the fact that other large utilities are now using Foster Wheeler Twin Furnace steam generators. The Twin Furnace arrangement with combination radiant and convection superheater permits constant final steam temperature through exceptionally wide load ranges.

FOSTER WHEELER CORPORATION **165 BROADWAY, NEW YORK 6, N. Y.**

FOSTER WHEELER

"Automatic" FIRE-FOG protection for large transformer room.

UNINTERRUPTED

POWER SERVICE . . .

an obligation to industry

Uninterrupted service is a cardinal principle in the furnishing of electrical power, an item of essential importance to the user. A transformer fire means more than the loss of electrical equipment and structures. Production losses from out-of-service time are non-replaceable.

Both utility companies and private users have for years been installing fire protection for key facilities. Through the relatively recent development of *Automatic* FIRE-FOG, the safe use of water for the extinguishment of electrical equipment fires, protection of large and small indoor and outdoor electrical installations is now practical from an economic point of view.

Automatic FIRE-FOG is specifically designed for your particular risk . . . electrically safe . . . approved by all leading insurance authorities.

We'll be glad to furnish engineering counsel on *Automatic* FIRE-FOG for your operations upon request . . . *no cost or obligation of course.*

Automatic FIRE-FOG
• IT BLANKETS • IT ISOLATES • IT QUENCHES •

. . . a famous member of the *Automatic Sprinkler* Family . . . provides basic fire protection for process equipment and storage in the chemical and petroleum industries. On-the-spot protection for quench tanks, dryers, explosive hazards, conveyor openings, air filters, oil filled electrical equipment and other units vital to production line operations.

"AUTOMATIC" SPRINKLER CORP. OF AMERICA
YOUNGSTOWN 1, OHIO

"Automatic" Sprinkler
FIRST IN FIRE PROTECTION
DEVELOPMENT - ENGINEERING MANUFACTURE - INSTALLATION
OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA

MORE NEW PRODUCTS
about which you should know

Pyrene Mfg Co, Newark, N. J., has available a combination solid stream or spray discharge **nozzle** and hose assembly for stored-pressure, vaporizing liquid extinguishers . . . . Ark-Les Switch Corp, 51 Water St, Watertown 72, Mass., manufactures single and multi-contact **plug-in terminals** with UL listing at 20 amp, 125/250-v, a-c. . . . Headly Mfg Co, 4326 W. Ogden Ave, Chicago 23, Ill., can supply molds with interchangeable numerals for casting **lead markers** to permanently identify underground or overhead cables; request Bulletin 349.

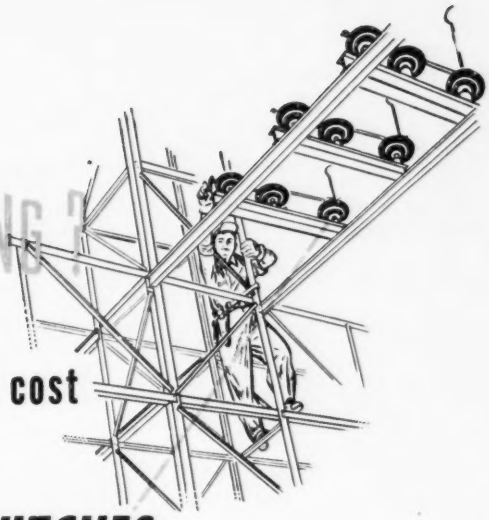
Micro Switch, Freeport, Ill., offers small, precision **snap-action switches** with five different actuator designs in 10 and 20-amp rating. . . . General Electric Co, Lighting and Rectifier Divisions, Schenectady 5, N. Y., has announced a high-voltage selenium **rectifier cell,** rated at 18 v output, for rectifier stacks where space is limited and continuous 24-hr operation for long periods is not required; request Bulletin GEA-5280. . . . The Trumbull Electric Mfg Co, Plainville, Conn., has designed NTPS lighting distribution **panelboards** with 6 or 12 circuits, to fit standard stud walls without projections; request Bulletin TEC-4.

Ideal Industries, Inc, 1021 Park Ave, Sycamore, Ill., has round-surfaced, steel **fish tapes** called Coil-Flex for use in all types of conduit, including aluminum; comes in 25-ft lengths with threaded couplings. . . . The Connecticut Hard Rubber Co, 407 East St, New Haven 9, Conn., manufactures rubber **vibration dampeners,** Shock Stops, for motorized equipment, which come in 18 x 18-in. sheets and round shapes of 3¼ and 2¼-in. diam.

Sigma Instruments, Inc, 45 Ceylon St, Boston, Mass., is marketing a temperature-compensated **relay** using a bimetal spring for operation at essentially constant voltage from −50 to +85 C, with voltage adjustments from 0.01 v up, at 5 to 25-mw sensitivities. . . . Durst Mfg Co, 11110 Cumpston St, North Hollywood, Calif., has electric **soldering pliers,** employing current-resistance principle, for work with 14 to 30 gage copper wire and for silver brazing small parts.

M. Black Mfg Co, 300 N. Third St, Philadelphia 6, Pa., manufactures a portable **trouble-light,** The Retracto-Reel, with 25 or 45 ft of cord on automatic locking and re-winding reel. . . . Buchanan Electrical Products Corp,

WHAT IS HE DOING?



Reducing switch installation cost 20 to 40% by installing

HI-VOLTAGE SWITCHES

HERE'S WHY . . . Every operating disconnect switch carries an expense in addition to its purchase price. From crate to operating position represents man hours and dollars.

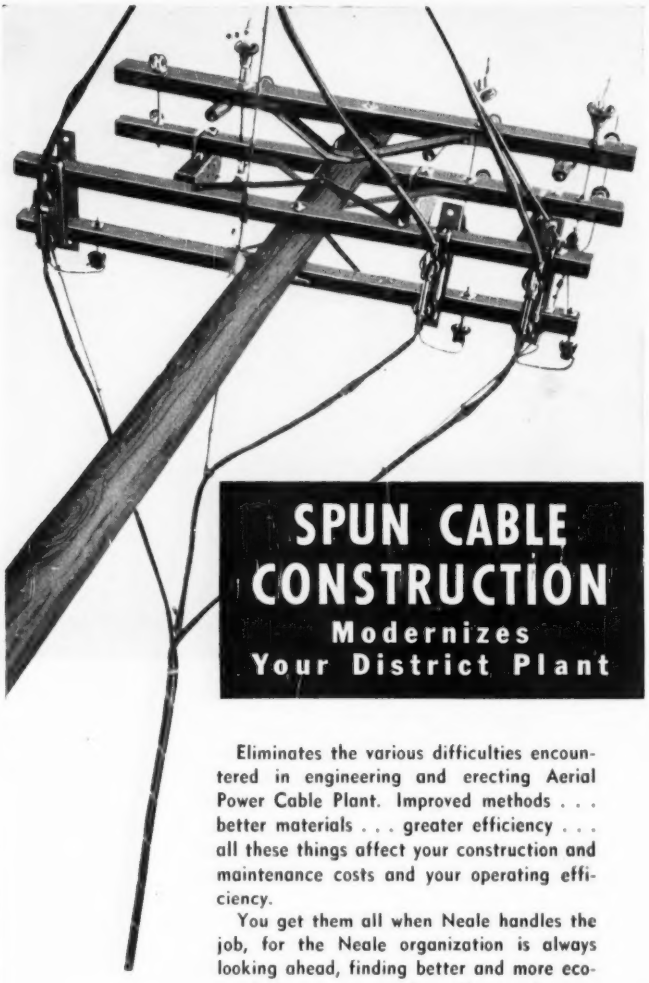
It will pay you to examine your switch installation costs. Compute, as we did, the cost of field cutting and drilling . . . the cost of parts identification . . . the cost of field fitting . . . the cost of final adjustment. Add them up. This is the saving that Hi-Voltage Switches offer.

The Hi-Voltage Switch Operating Mechanism is pre-machined and pre-fitted at the factory. All parts are positively identified . . . keyed to easy-to-follow installation data. Every Hi-Voltage Switch is completely assembled and tested before shipment. This is the work we save your construction crew.

Specify Hi-Voltage and gain the advantages of lower installation costs, more accurate installation, more certain operation. After all . . . it's the installed cost that counts.

HI-VOLTAGE EQUIPMENT COMPANY

4000 EAST 116TH STREET • CLEVELAND 5, OHIO



SPUN CABLE CONSTRUCTION

Modernizes Your District Plant

Eliminates the various difficulties encountered in engineering and erecting Aerial Power Cable Plant. Improved methods . . . better materials . . . greater efficiency . . . all these things affect your construction and maintenance costs and your operating efficiency.

You get them all when Neale handles the job, for the Neale organization is always looking ahead, finding better and more economical ways to produce the results you want.

Typical of this constant striving for improvement is the Neale Model "K" Cable Spinner, created and perfected as a practical solution to the varied problems that arise in connection with power line construction and maintenance.

Spun Cable Construction Services Coast to Coast!

The Neale organization is made up of practical, experienced men working with the most modern and efficient equipment available. Let them help you on your next erection or maintenance job.

NEALE CONSTRUCTION CO.
ENGINEERING • CONSTRUCTION • MAINTENANCE
TOPEKA, KANSAS PHONE 4-2621

1290 Central Ave, Hillside, N. J., has developed a solderless type, molded **terminal block** which takes wires No. 16 to 6 AWG, is rated 35 amp at 600 v and is available in 4, 8 and 12-circuit sizes.

Hobart Brothers, Troy, Ohio, announced the No. 313 **electrode** for short, intermittent welds at high speeds on all gages of steel using a-c or d-c power, straight or reverse polarity; available are 12-in. lengths in $\frac{3}{32}$ in. diam only and 14-in. lengths in $\frac{1}{8}$, $\frac{5}{32}$ and $\frac{3}{16}$ in. diam. . . . Fischer & Porter Co, Hatboro, Pa., have designed the Magna-Sight **flow indicator** for clear and opaque streams that measures flow rates of 3.5 to 250 gpm, in sizes from $\frac{3}{4}$ to 4 in., screwed or flanged. . . . Eisler Engineering Co. Inc, 750 S. 13th St, Newark 3, N. J., has available a **sputter welder** in ratings from $\frac{1}{2}$ to 3 kva for use in industries manufacturing light metal commodities of nickel, silver, brass, low carbon and stainless steels, etc.

Prufcoat Laboratories, Inc, 63 Main St, Cambridge 42, Mass., offers a **paint folder**, the Prufcoat Proof Packet, which contains information about the use and specification of protective coatings for situations involving acids, alkalies, oil and water. . . . J. H. Matthews & Co, 3861 Forbes St, Pittsburgh 13, Pa., announces the 222 **nameplate marking machine** for production marking of nameplates where frequent changes in character alignment and plate size occur.

Aircraft-Marine Products Inc, 1656 N. Fourth St, Harrisburg, Pa., manufactures **plug-in leads** using all types of stranded wire and having a flexible plastic insulation said to be unaffected by oil, grease, age or sunlight and temperatures up to 170 F. . . . Sheldon Electric Co, Inc, Irvington, N. J., announces two fluorescent **lamp starters** claimed to be the first practical units for the new 25-w 33-in., 85-w 60-in. and 8-w Circlarc lamps; both have UL approval.

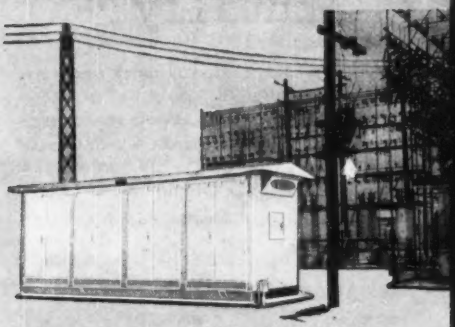
General Scientific Equipment Co, 2700 W. Huntingdon St, Philadelphia 32, Pa., has **water rectifiers** which stop scale formation and remove old scale and rust from sterilizers, autoclaves, stills and instruments. . . . Kenrich Corp, 120 Wall St, New York 5, N. Y., makes a synthetic **resinous hydro-carbon** called Kenflex recommended for vinyl insulated wire, electrical cable filling and potting and caulking compounds. . . . Wagner Electric Corp, 6489 Plymouth Ave, St. Louis 14, Mo., is offering a sleeve bearing **replacement tool** (steel rod) for replacing worn bearings in motor endplates with new ones in one operation; available for finished bearing sizes of 0.655, 0.751, 0.812 and 1.062 in.

A FIELD PROVED · PERFORMANCE RECORD

CORNELL-DUBILIER CAPACITORS

PRODUCED BY SPECIALISTS IN POWER-FACTOR CAPACITORS

Utilities throughout the world confirm the average of more than a decade of trouble-free service, in the field, delivered by C-D Capacitors. They've learned that C-D specialized experience pays off . . . that C-D Capacitors stand for Consistent Dependability. Your inquiries are invited. Cornell-Dubilier Electric Corporation, Dept. D69, South Plainfield, New Jersey. Other plants in New Bedford, Worcester and Brookline, Mass.; Providence, Rhode Island; Indianapolis, Indiana and Cleveland, Ohio.



A western utility application of C-D capacitors to help meet emergency power demands, the result of unusual load growth.

Follow the leaders
Demand dependable C-D Capacitors—built by capacitor specialists.

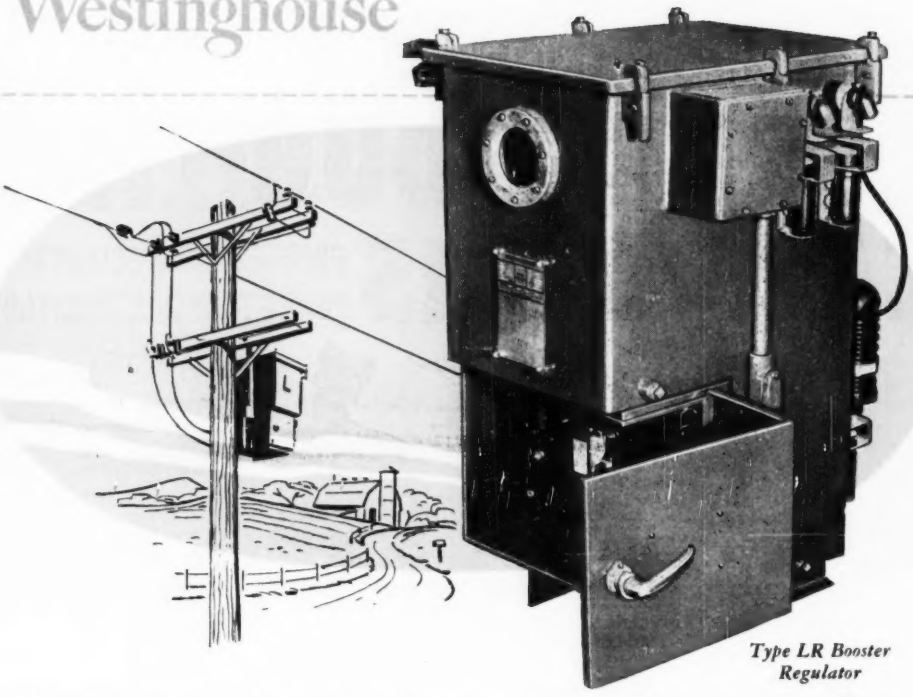
1916 1949
Reg. U. S. Pat. Off.

C-D Best by Field Test!

CORNELL-DUBILIER WORLD'S LARGEST MANUFACTURER OF CAPACITORS

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



Type LR Booster Regulator

"Booster Regulators Eliminated 500 Customer Complaints Annually!"

This statement from a midwestern utility superintendent is backed by his own records. They prove Westinghouse Booster Regulators pay their way with customer satisfaction.

"Greatly increased load on our rural lines created serious voltage problems. Customers complained of burned-out motors, dimmed lights and late dinners. The installation of Westinghouse Booster Regulators eliminated these complaints and *substantially increased our revenue.*"

Types LR and BR Booster Regulators are compact, pole-mounted units. They provide reliable voltage control for rural lines. *Their investment costs, as compared with other methods, are slashed as much as 95%!* Installation is quick and easy. Maintenance is negligible.

For complete information about *every* voltage regulation need, call your nearest Westinghouse office, or write for C. S. 47-225, 47-230, B-4245 and Distribution Digest 50-000. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70530

Westinghouse Voltage Regulators

FOR *ANY* SYSTEM

NEWS ABOUT PEOPLE

R. C. Hienton Made Sales Manager in Cleveland

Announcement has been made of the appointment of Robert C. Hienton to succeed Jack E. North as general sales manager of the Cleveland Electric Illuminating Co.

Mr Hienton's present position as manager of the industrial sales department will be assumed by J. R. David. Raymond E. Mausk will succeed Mr David as supervisor of the industrial sales department for the central and

ROBERT C. HIENTON

western districts and Randall J. Miller will take over Mr Mausk's present position of assistant to the general sales manager. Mr Miller has been assistant manager of residential sales.

One of Cleveland's best known sales executives and a national leader in the electrical sales field, Mr North joined the Illuminating Company in 1919. He was named director of residential sales in 1934 and became general sales manager in 1943. One of his first assignments after joining the company was to draw up the first promotional program for the Electrical League of Cleveland, in which he has been very active since 1920. He became president of the League in 1923 and served continuously in that position until last January. In 1933 Mr North received the James H. McGraw Medal, for fostering cooperation in the industry. He was also the first president of the International Association of Electrical Leagues and chairman of the National Better Light-Better Sight Bureau.

Mr Hienton, who has been manager

JACK E. NORTH

of industrial sales for the past year and a half, has worked closely in recent years with most of the industrial companies that have either located in the Cleveland-Northeast Ohio area or have expanded their production facilities in that region. He was located in the company's eastern district headquarters at Ashtabula from 1928 to 1942. He was director of the industrial development division from 1943 to 1947.

•

M. L. Waring, planning engineer of Consolidated Edison Co of New York, Inc. since 1947, has been elected an assistant vice-president. Mr Waring will assist James F. Fairman, vice-president in charge of electric and gas production and operation. In 1933 he joined the New York Edison Co, a predecessor of Consolidated Edison, as a junior engineer. Three years later he was made an assistant engineer. Following military service in World War II, he returned to Consolidated Edison, spending a year on the company's executive development program. Since 1947 he has been responsible for planning the development of the system's electric, gas, and steam properties.

Dr Carl C. Chambers, professor of electrical engineering at the University of Pennsylvania, has been appointed acting dean of the University's Moore School of Electrical Engineering for a one-year term. Dr Chambers will succeed **Dr Harold Pender,** who has had a distinguished career as Dean of the Moore School since 1923 and who will retire from the deanship on July 1.

F. W. Russell Elected V-P, Louisville Gas & Electric

F. W. Russell, general superintendent of Louisville Gas & Electric Co, Louisville, Ky., for the past seven months, has been elected vice-president

F. W. RUSSELL

in charge of operations. He succeeds the late Addison W. Lee.

A graduate of Purdue University with a degree in mechanical engineering, Mr Russell has been with the company for the past 24 years.

A. G. Rosenbaum has been appointed general superintendent to succeed Mr Russell. Mr Rosenbaum joined the Louisville utility in 1923 and was made assistant superintendent of the steam production department in 1939 and superintendent of steam production in 1946.

F. B. Tetzel has been named to succeed Mr Rosenbaum.

•

Carl F. Myers, formerly engineer in charge of overhead construction for the Puget Sound Power & Light Co at Seattle, Wash., has joined the Electric Bond & Share Co. He is now at Ebasco International in New York on an engineering assignment on electric properties.

Arthur E. Grunert, chief operating engineer of the Commonwealth Edison Co, Chicago, has retired after more than 40 years of service with the company. More than 400 friends and associates gathered at a dinner held at the Palmer House, Chicago, to honor him.

on the occasion. He has been chief operating engineer since 1947. Mr Grunert's primary interest has been in fuel burning and steam generation.

•

Cliff Appointed General Commercial Manager

Changes in organization in the commercial department of the Public Service Electric & Gas Co. Newark, N. J., have recently been announced.

Herbert E. Cliff, formerly assistant general commercial manager, has been made general commercial manager, succeeding John L. Conover, retired. Gordon M. Peterson, formerly assistant to

HERBERT E. CLIFF

the general commercial manager, has been named assistant general commercial manager, and Louis R. Quad has been promoted from division commercial manager, central division, to assistant general commercial manager.

Starting with Public Service in 1924 as a commercial cadet, Mr Cliff spent many years in the company's gas department before he was appointed assistant general commercial manager in 1940.

•

John R. Frederick, commercial and industrial sales manager for the Wisconsin Power & Light Co, Madison, has been named director of industry development. He will work in close cooperation with district managers.

Robert C. Wilson has been appointed manager of sales at the Norwood, Ohio, works of the Trumbull Electric Mfg Co, Plainville, Conn. Mr. Wilson joined the sales division of Trumbull last year.

B. W. Alvey has been appointed supervisor of water heater sales for Frigidaire Division, General Motors Corp. Mr Alvey has been connected with electric water heater selling for 20 years.

L. R. PATTERSON

Patterson Receives New Engineering Assignment

L. R. Patterson, formerly staff engineer, electric operations, has been named superintendent, electric system planning, by the Public Service Co of Colorado, Denver.

Mr Patterson joined Public Service in 1923 as a draftsman in the electric distribution engineering department and has filled various engineering assignments in the electric operating department.

•

Arthur A. Blue has been appointed manager of the instrument division of Thomas A. Edison, Inc, West Orange, N. J.

Homer Graves, assistant designing engineer on Ross Dam, has retired from City Light engineering department at Seattle after 27 years of enginering work on the Skagit hydroelectric project.

Milton H. Fies, manager of mine operations for the Alabama Power Co, has been named a consulting engineer for the Office of Synthetic Liquid Fuels, Bureau of Mines. Dr Fies will continue in his position with Alabama Power.

Vincent M. Montsinger, research engineer in the power transformer engineering division of the General Electric Co, has retired after completing 39 years of service. Mr Montsinger joined GE in 1909.

Sidney L. Chertok has been appointed to the application engineering staff of Sprague Electric Co, North Adams, Mass. Mr Chertok will also serve as sales promotion manager of the Sprague Products Co, jobbers' distributing organization for Sprague products.

H. A. Glover Made Sales Administration Manager

Announcement has been made by the S&C Electric Co, Chicago, of certain changes designed to extend sales department structure and scope. Under this revision, H. A. Glover, formerly assistant sales manager, has been made sales administration manager and R. S. Barbaras joins the organization as sales promotion manager.

For a number of years, Mr Glover was occupied in Pittsburgh, Pa., in various electrical engineering duties with West Penn Power Co, Duquesne Light Co, and Carnegie-Illinois Steel Corp. Later his association with the sales department of I-T-E Circuit Breaker Co, Philadelphia, was interrupted by three years in the U. S. Navy. He joined S&C as sales department supervisor in 1946.

H. A. GLOVER

Mr Barbaras has been a member of the sales engineering staff of the radio division of Western Electric Co in New York. Earlier connections were with the National Vulcanized Fibre Co and National Insulation Co. From 1941-45 he served in the U. S. Army Signal Corps in the China-Burma-India theater.

•

M.W.Smith Made President, Baldwin Locomotive

Marvin W. Smith, executive vice-president of the Baldwin Locomotive Works since last July, has been elected president and chief executive officer of the company.

Mr Smith went to Baldwin from the Westinghouse Electric Corp, where he had served as vice-president in charge of engineering and research. He had joined that organization shortly after his graduation from Texas A and M in 1915. During the period from 1917 to

It cuts down your overhead when your "OVERHEAD" cuts up!

OVERHEAD MAINTENANCE headaches are headed off when you have the right trucks for the job. *You have,* when you have Internationals working for you.

Look at the 3 ways these hard-workers help you:

1. They're right for the job!

Sure, International gives you the right trucks for overhead maintenance. But more, it gives you the right trucks for every kind of utility job. International builds a complete line from the half-ton size up. There are 22 basic International models, 1,000 different truck combinations. Gross weight ratings range from 4,400 to 90,000 pounds.

2. They're rugged!

You may not appreciate an extra margin of stamina, dependability, and ruggedness on *every* job—but you will on some! For example: you'll be mighty thankful for International's extra heavy-duty design and construction. And you'll be mighty glad that the International engine has all that power.

3. They have a service set-up to shorten "lay-up."

When utility-owned trucks are laid up, that also ties up equipment mounted on 'em. That's a double headache. And it's a big reason why you'll want to have International's service organization backing you up. Its 4,700 Dealers and company-owned Branches have the parts, the tools, the mechanics to keep your trucks as hale and hearty as the day they rolled off the assembly line.

Whenever you need any kind of trucks for any kind of maintenance or construction work remember this: International offers you a complete truck line, completely dependable, backed by America's most complete, exclusive truck service organization. For complete truck satisfaction, get in touch with your nearest International Dealer or Branch.

Other International Harvester Products . . . Industrial Power
Farmall Tractors and Machines . . . Refrigeration

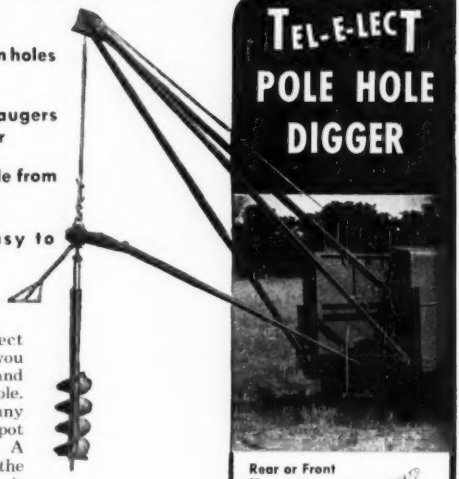
Tune in James Melton and "Harvest of Stars"
NBC, Sunday afternoons

INTERNATIONAL TRUCKS

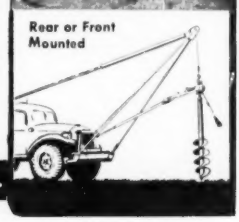
INTERNATIONAL HARVESTER COMPANY • CHICAGO

Operates ON ANY DERRICK TRUCK

- Adjustable for clean holes to 8 ft. deep
- Interchangeable augers 9" to 16" diameter
- Drills a straight hole from any truck position
- Easy to use—easy to transport



WITH the Tel-E-Lect Pole Hole Digger, you use the same truck and crew that sets the pole. You can drill a hole any place that you can spot the pole derrick. A single bolt attaches the digger to the truck; it works suspended from the derrick. Powered by the truck motor through a power take-off shaft, Tel-E-Lect is raised and lowered by the winch line. Fits the budget of even the smallest utility, and quickly pays for itself. *Ask for circular.*



TEL-E-LECT PRODUCTS, *Inc.*

9603 MINNETONKA BOULEVARD, MINNEAPOLIS 16, MINNESOTA

New Capacitor cuts costs on outdoor Motor Installations

A NEW LINE of G-E capacitors closely matches kvar requirements of 3 to 15 hp motors. These units economically:

Raise Power Factor

Cut Voltage Drop

Permit Use of Smaller Conductors and Transformers

Cut Cost of Purchased Power

PRICE IS LOW compared with that of units previously available for this service. Rating is 460-volts, 3-phase, 60-cycles.

EASILY MOUNTED in any position for direct connection to the motor starter, they automatically provide power factor improvemen as needed.

FOUR-FOOT FLEXIBLE LEADS, shown in photograph, are weathertight and can be used with or without conduit.

For full information, write *Apparatus Dept., General Electric Company, Pittsfield, Mass.*

GENERAL ELECTRIC

1930 Mr Smith was instrumental in the development of many important power generating projects.

•

John C. Parker Retires As Consolidated Edison V-P

John C. Parker has retired from his position as a vice-president of the Consolidated Edison Co of New York, Inc.

Mr Parker joined the former Brooklyn Edison Co, a subsidiary of Consolidated, in 1922 as electrical engineer and later became vice-president in charge of all Brooklyn Edison engineering.

From 1932 to 1936 Mr Parker served as president of Brooklyn Edison. When that company was merged into Consolidated Edison in 1936, he became a vice-president in the parent company and was responsible for the departments engaged in research and development. Recently he has been engaged in consultative duties and special assignments.

He is a past-president of the American Institute of Electrical Engineers. At present he is on the U. S. executive committee of the World Power Conference.

•

J. C. Atkins, has been appointed heating industry specialist for Cutler-Hammer, Inc, Milwaukee. Mr Atkins has been associated with the company's electric heating devices for a number of years.

Paul L. Palmerton has been appointed director of public relations of the Western Electric Co, New York. Mr Palmerton was formerly comptroller of the company's purchasing and traffic division. He succeeds **Fred B. Wright,** retired.

James T. Lawson, who has been electrical operating engineer in the electric generation department, Public Service Electric & Gas Co, Newark, N. J., since 1931, has retired after more than 51 years' service with Public Service and predecessor companies.

M. S. Miksch has been appointed purchasing agent for the Pacific Power & Light Co, Portland, Ore., in order to relieve veteran **J. B. Kilmore** of the heavy responsibilities he has carried for many years. Mr Miksch was formerly assistant purchasing agent and has been with the organization since 1925.

J. Gilman Reid has been appointed chief of the engineering electronics laboratory of the National Bureau of Standards. One of the senior scientists in the Bureau's radio proximity fuse

In Business Machines, too . . .

MALLORY CONTACTS

help keep track of the nation's figures

Truly mechanical brains, today's business machines are marvels. Without them, modern business, science or education could not perform at their streamlined pace.

And the efficiency of these machines is rooted in electrical impulses—split-second impulses, faithfully executed by Mallory Contacts . . . as dependable and accurate as the machines themselves.

Mallory Contacts are so often the first choice by business machine makers because these sturdy, wear-resistant contacts are precision made to meet unusual and exacting standards. For example, in the processing of tungsten materials, the most rigid control is exercised. The resultant interlocking grain structure keeps erosion down over long periods of heavy duty. Whether the requirements are for tungsten, silver-alloy or platinum-alloy contacts, you can depend on Mallory for longer wear and finer quality.

What's Your Problem?

From business systems to automobile ignition systems—from thermostat controls to outboard motors—you'll find numerous types of Mallory Contacts doing special jobs with the utmost efficiency and dependability. Mallory has designed so many types of contacts that even when the most unusual problems arise, you'll usually find a Mallory Contact to solve them. But if you don't, just call in a Mallory engineer.

For all kinds of contact materials and service, Mallory is your most dependable and experienced source.

In Canada, made and sold by Johnson, Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario

Electrical Contacts and Contact Assemblies

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors — Rectifiers
Contacts — Switches
Controls — Vibrators
Power Supplies
Resistance Welding Materials

TIGHT CONNECTIONS
assured by using
PALNUT
TRADE MARK
SELF-LOCKING NUTS

• The Railway & Industrial Engineering Co. overlooks no details to insure years of satisfactory service from its products. An example is the use of PALNUTS to assure permanently tight nut-and-bolt assemblies on its line of fittings, switches, clamps, cutouts and other R. & I. E. equipment.

TIGHT connections are vital in the distribution and transmission of Power. That's why you see PALNUTS on wood pole lines, steel transmission towers, bus fittings, connectors, switchboards, terminals, substations and other electrical equipment.
PALNUTS apply quickly on top of regular nuts, holding them to original tightness under severe vibration. No check-ups or re-tightening are required. On electrical connections, perfect conductivity is maintained. PALNUTS are available in a wide range of sizes in plain spring tempered steel; also hot-dip galvanized and silicon bronze for weather resistance.
Send details of your needs for samples. Write for literature on entire line.

THE PALNUT CO.

51 Cordier St.,
Irvington 11,
N. J.

DOUBLE-LOCKING
PALNUTS
Trademark Reg. U. S. Pat. Off.

program during World War II, Mr Reid has conducted research on electronic instruments, automatic reflux controls for isotope separation, auxiliary instruments for mass spectrographs, heat transfer, and thermal conductivity. He joined the Bureau of Standards staff in 1937.

John E. Menz, has been appointed product manager, electrical conductor, to direct the sale of Kaiser aluminum cable and other products produced at the Permanente Metals Corp's new rod, bar, wire, and cable plant at Newark, Ohio. Mr Menz has been associated with the aluminum industry for several years in both sales and production management capacities. He joined Permanente in 1946. His headquarters will continue to be in Oakland, Calif.

R. A. Schmidt, of Lausanne, Switzerland, has been elected president of CIGRE (International Conference on Large Electric Systems) to succeed Ernest Mercier, who has been president since 1934. Appointed in 1919 as chief engineer of the Societe Anonyme d'Energie de L'Ouest Suisse when this society was founded, he quickly rose to the position of manager and later of member of the board of directors. For 15 years he has been president of the Union des Centrales Suisses d' Electricite.

Robert Cutler, president of the Cutler Light Manufacturing Co, Philadelphia, was elected president of the Fluorescent Lighting Association at the recent annual meeting in New York. Other officers elected included: vice-presidents, Edward Miller, Acme Eectric Co, Cuba, N. Y., and Abner Byer, Cold Cathode Lighting Corp, New York; secretary, Victor Todd, Swedish Iron & Steel Corp, New York and treasurer, Miles Pennybacker, Voltare Tubes, Inc, Norwalk, Conn.

Ted Gravenson has been appointed sales promotion manager of the Burndy Engineering Co, Inc, New York.

E. Lowe McIntyre, Jr. has been appointed assistant sales manager of the Electric Products Co, Cleveland, Ohio, in charge of new market developments.

Leonard Schafer has been appointed assistant sales manager, Chicago factory territory, Hubbard & Co, Pittsburgh, Pa. Mr Schafer started with Hubbard 24 years ago.

George J. Nicastro, sales engineer, Combustion Engineering-Superheater, Inc, New York, has been elected president of the New York State Society of Professional Engineers.

John R. Ford has been appointed general sales manager of the Jefferson Electric Co, Bellwood, Ill. Mr Ford has been associated with Jefferson for the past 19 years in various capacities. He was Milwaukee representative from 1930 to 1932, at which time he was transferred to Minneapolis. From 1935 to 1944 he covered the Northwest area for the company, with headquarters in Seattle, Wash. Mr Ford returned to the factory in 1944 in charge of material procurement for war contracts. Since the end of the war, Mr Ford has been sales representative in the Chicago territory.

John M. Bess, who resigned his executive connection with Noma Electric Corp last year to devote himself to several independent reorganization projects, has resumed his former position as executive vice-president of Noma Electric Corp of Maryland.

OBITUARY

Joseph H. Yarnall, 65, formerly superintendent of power for the Boston Elevated Railway, now the Metropolitan Transit Authority, died at Newtonville, Mass., June 5. Born in Sunbury, Pa., and a graduate of Pennsylvania State College in electrical engineering, he was employed by the General Electric Co at Lynn, Mass., before joining the transit system at Boston. He retired in 1946.

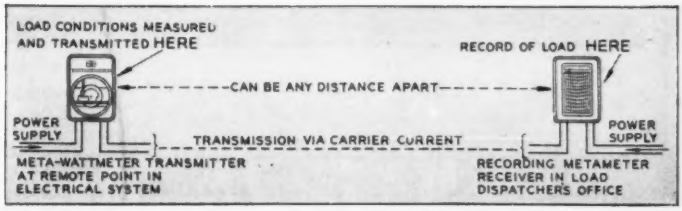
Ross C. Lynch, a member of the Bonneville Power Administration advisory board, died suddenly at his home in Yakima, Wash., on May 31 as the result of a heart attack. A strong public power advocate, Mr Lynch ran last year for Yakima County PUD commissioner but was defeated. He was born in Yakima 54 years ago.

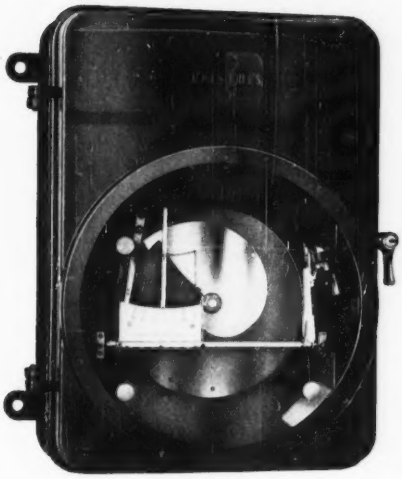
Henry W. Kimmel, vice-president of the Taylor Instrument Companies, Rochester, N. Y., died on May 26. He was 72 years old. Mr Kimmel started with the Taylor organization in 1896. He was named president of the Taylor Instrument Company of Canada, Ltd. and vice-president of the Rochester company 14 years ago.

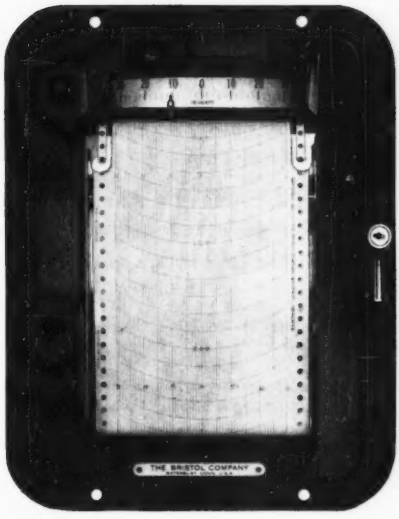
C. C. Bartlett, 61, district manager of the Southern California Edison Co in Redondo Beach, Calif., for more than 20 years, died at his home there on May 23, of a heart ailment.

Grover C. Meyer, industrial engineer, Kansas City Power & Light Co, Kansas City, Mo., died on June 2. He was 56 years old. Mr Meyer was a member of the American Institute of Electrical Engineers.

HOW TO PREDICT AND PREVENT TROUBLE FROM A DISTANCE


LOAD CONDITIONS MEASURED AND TRANSMITTED HERE
RECORD OF LOAD HERE
CAN BE ANY DISTANCE APART
POWER SUPPLY
TRANSMISSION VIA CARRIER CURRENT
POWER SUPPLY
META-WATTMETER TRANSMITTER AT REMOTE POINT IN ELECTRICAL SYSTEM
RECORDING METAMETER RECEIVER IN LOAD DISPATCHERS OFFICE





Accurate readings of Voltage, Current, Power, Reactive Volt Amperes, and Totalized Load miles away come to you promptly and continuously when your system is watched and reported on by Bristol's Metameter System of Telemetering.

Observations picked up at remote points are recorded by Metameter Receivers at the central station or dispatcher's office . . . give you a complete and visual picture of what is taking place in your system . . . enable you to anticipate abnormalities and prevent emergencies from developing.

The impulse-duration principle on which the Bristol Metameter System of Telemetering works gives you a choice of transmitting media: carrier channel . . . simple two-wire circuit . . . radio beam . . . or any convenient circuit you may select. For full description, write for Bull. M1702. THE BRISTOL COMPANY, 116, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont. Bristol's Instrument Co., Ltd., Lynch Lane, Weymouth, Dorset, England.)

Among uses of the Metameter are:

FOR LOAD DISPATCHER OF CENTRAL STATION SYSTEM

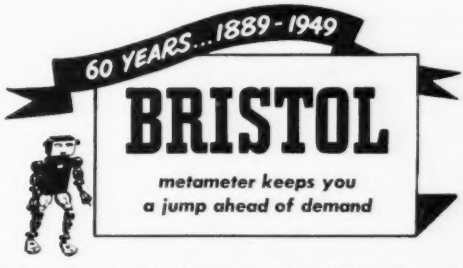
1. Load (active and reactive power and power demand) in each tie-line interconnecting system with neighboring system.
2. Output, or total generated power, of each generating station.
3. Total output of all generating stations, on a single instrument.
4. Active and reactive power and power demand at key points on important transmission circuits.
5. Water level and waterwheel gate position in hydro-electric plant.

FOR OPERATOR OF GENERATING STATION

1. Total output generated in system.
2. Output of each associated attended or unattended generating station in system.
3. Desired output of operator's own station.

FOR DISPATCHER OF DISTRIBUTION SYSTEM

1. Total kilowatt load on unattended substations.
2. Bus voltage of unattended station.
3. Feeder amperes.



AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

MANUFACTURERS and MARKETS

LOOKING OVER I-T-E's new line of current transformers are A. J. Panichelli, left, advertising manager of I-T-E; John F. Gries, account executive of The Richard A. Foley Advertising Agency, Inc., Philadelphia; Ray E. Murphy, I-T-E vice-president; Mrs. Jean Shirley; and J. Fred Getz, I-T-E sales manager. The new line of transformers was introduced at the company's annual sales conference at the Bedford Springs Hotel, Bedford, Pa., attended by 134 I-T-E representatives and subsidiary representatives

Leeds & Northrup Holds Fiftieth Anniversary

Leeds & Northrup Co, Philadelphia, celebrated its fiftieth anniversary on June 4 by playing host to 3,500 employees and their guests in Convention Hall. C. S. Redding, president, presided at a dinner at which a gold 50-year service plaque and a bound testimonial were presented to Morris Evans Leeds, founder of the company and now chairman of the board.

The testimonial was presented to Mr Leeds jointly by Robert Craig, president of the Leeds & Northrup Cooperative Association; J. H. Swope, president of the Leeds & Northrup Employees' Union, and Mr Redding.

•

Universal Opens $1,000,000 Promotion on Coffeematic

Launching what it claims to be the first $1,000,000 promotion on one small appliance, Landers, Frary & Clark, New Britain, Conn., has opened its campaign, Coffeematic's Million Dollar Party. Continuing throughout 1949 right up through Christmas, Universal's million dollar party will carry to millions of housewives throughout the country the story of Universal Coffeematic. The campaign will feature a series of a big promotions aimed at the bridal market, gift, anniversary and similar events and will be topped off by a gigantic Christmas promotion.

Universal's new eight-cup Coffeematic features the "Flavor-Selector," a red slide at its base which when set to "mild," "medium" or "strong," automatically brews coffee to the proper strength. It is priced at $24.95.

•

Insulator Prices Reduced

Locke, Inc, Baltimore, Md., reduced the prices on suspension insulators, 10" and larger in diameter, by approximately 8%, effective May 24.

•

Westinghouse Wage Talks

Westinghouse Electric Corp has agreed to open negotiations June 23 with the United Electrical Workers, CIO, on the union's wage demands.

A-C Reaches Agreement with Three Labor Unions

The Allis-Chalmers Manufacturing Co has reached new labor agreements with three unions representing approximately 750 employees. The latest agreement is with the CIO United Electrical Workers' Union, No. 239, representing 600 employees at its Hyde Park, Mass., plant. The new contract provides for no immediate wage increase, but either party may reopen wage negotiations once. In other respects, the contract is generally similar to the old agreement.

Contracts have been signed with two AFL unions at the West Allis works. The maintenance electricians are represented by the AFL International Brotherhood of Electrical Workers, Local B663, and it includes approximately 85 employees. The other agreement is with the AFL firemen and oilers, representing about 60 powerhouse employees.

A contract already has been announced with Local 765 of the CIO United Electrical Workers, covering about 1,100 employees at the A-C plant in Norwood, Ohio. At Springfield, Ill., an interim agreement also has been announced with the CIO United Automobile Workers' union, which recently won the bargaining rights from the CIO Farm Equipment Workers' union.

Contract with Local 248 of the UAW-CIO, covering 11,000 production employees at the West Allis works does not expire until July 1; contracts at the La Porte, Ind.; Gadsden, Ala.; and LaCrosse, Wis., works run until 1950.

•

Leece-Neville Announces New Expansion Program

Leece-Neville Co, Cleveland, has announced plans for expansion and improvement of its facilities which are expected to greatly enhance production efficiency.

The company's old plant at 5363 Hamilton Ave has been sold and the other plant at 5109 Hamilton Ave, purchased during the war, will be the center for both production and administration. A plot 68 x 312 ft, adjacent to the plant at 5109 Hamilton, has been acquired, and additional floor space will be provided immediately by erection of

AT LAST!

THE ORIGINAL

NIFE

NICKEL CADMIUM STORAGE BATTERY

IS AVAILABLE TO AMERICAN INDUSTRY

Here is the ***original NIFE Nickel Cadmium Battery.*** Here finally is the real solution to your battery and lighting problems!

An especially ideal source of storage battery power, ***NIFE*** is in widespread use in many nations throughout the world.

Unquestionably the most desirable alkaline storage battery in the world, ***NIFE*** is currently available to American industry for train and ship lighting, diesel motor starting, relay tripping, and as an electric vehicle power source.

NIFE INCORPORATED will be pleased to introduce the ***original Nickel Cadmium Storage Battery*** to your organization. Your requests for literature and supplementing data are invited; all inquiries will receive prompt attention.

a temporary structure pending completion of plans for a permanent addition. Another building also will be retained and expanded.

In announcing the expansion program, S. Floyd Stewart, president, said sales were good during the first six months of the current fiscal year, and if continuing on a like basis should at least equal last year's $4,578,635.

•

Hotpoint Launches New Electric Range Promotion

With the production of its two-millionth range, Hotpoint, Inc, has launched a nationwide electric range promotion by means of large cooking schools conducted by dealers in 100 key city markets. Aimed at educating housewives to the benefits of electric cooking on a mass scale never before approached in the industry, the key city promotion will kick off a series of supplementary dealer range activities in local markets throughout the summer and fall.

Announcing the promotion to the company's field organization, Leonard C. Truesdell, vice-president of marketing, said that the theme will be the "golden era of modern cooking".

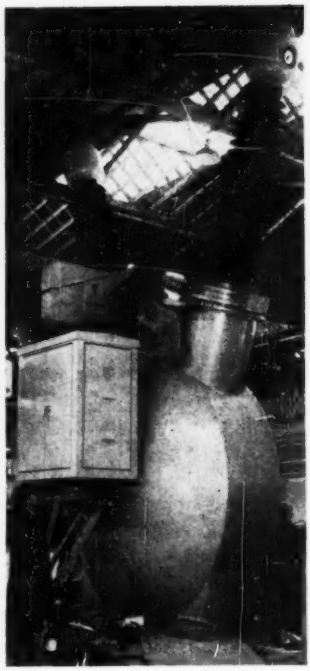
The basis of the promotion will be large cooking schools sponsored jointly by distributors and dealers, and held at auditoriums or theaters which will accommodate several thousand persons. As an incentive for attendance, dealers are giving away tickets which qualify customers for admission as well as for a prize drawing. Top price at each cooking school will be an RC-11 push-button range with a special "two-millionth range" medallion on the backsplasher. Dealers who have the largest number of consumers attending also will receive prizes.

Hotpoint field personnel will work with dealers and distributors in carrying out the nationwide promotion. Following the initial schools in 100 cities, utility companies, as well as dealers, will conduct cooking demonstrations on a smaller scale in their own communities.

•

Fluoroscope Test Used on Electrical Connectors

Mines Equipment Co, 4235 Clayton Ave, St. Louis, Mo., is using an X-ray equipment for fluoroscopic views of its industrial plugs and receptacles. After tests of the integrally molded Neoprene devices, a final "look inside" is made to check correctness of wire lay, insulation thickness, and soldering.



LARGEST single piece of electrical equipment ever shown at the British Industries Fair was this 275,000-v oil-break circuit breaker, 23 ft high and weighing ten tons. It was manufactured by British Thomson-Houston Co. The fair was held in May

British Company Acquires South Africa Interests

(McGraw-Hill World News)

Associated Electrical Industries of England, which controls several large British electrical manufacturing companies, will acquire a substantial shareholding in First Electric Corporation of South Africa.

First Electric will acquire the capital of L. H. Marthinusen Limited and National Electrical Manufacturers (Pty) Ltd, together with the rights over a loan previously made by Associated Electrical Industries to Marthinusen.

In 1947, Associated acquired, through Metropolitan Vickers, L. H. Marthinusen Ltd as a nucleus for the manufacture of electrical engineering plant and equipment in South Africa. At the same time Vanderbijl Engineering Corp acquired a 35% interest in Marthinusen and in National Electrical Manufacturers (Pty) Ltd.

Associated Electrical Industries and Vickers group include Metropolitan Vickers and British Thomson-Houston.

GE Sponsors National Lighting Competition

A nationwide lighting competition, sponsored by General Electric Co in connection with the electrical industry's comprehensive Planned Lighting Program, has been announced by the GE Lamp Department, Nela Park, Cleveland. The competition features 192 cash awards, having a total value of $21,000.

Termed "Certificates of Appreciation," the awards are in amounts of $100 and $150. Eligible to receive the $100 awards are individuals who will have played key roles in the planning, selling, and supply concerning the 36 outstanding Planned Lighting installations of 1949. The $150 certificates are being offered as additional awards to persons submitting reports of winning installations.

Twenty-four of the winning installations will be in the commercial and industrial lighting classifications. The remaining 12 will be in the residential lighting category.

•

Phelps Dodge Curtails Production of Copper

Phelps Dodge Corp has announced that it will cut its domestic output of copper about 5,000 tons monthly as a result of the decline in demand. Previously, Anaconda Copper Mining Co had announced the suspension of operations at one of its Montana mines. Kennecott Copper Corp has lowered its output by cutting operations in several of its mines from 48 to 40 hours a week. On May 1 the copper mines of Calumet & Hecla Consolidated in Michigan were closed because of the lack of demand and the price situation.

It is estimated that this curtailment program has already reduced domestic output of copper by about 13,000 tons monthly.

•

Moves Boston Office

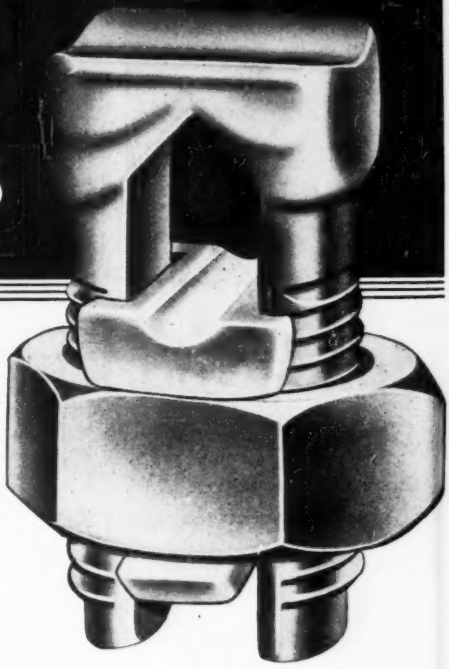
Cutler-Hammer, Inc, Milwaukee, has recently announced a change of address for its Boston district sales office. Headed by C. V. Topliffe, the new office is located at 784 Commonwealth Ave, Boston 15.

•

Fuel Prices Cut Again

The Standard Oil Co of California has reduced fuel oil prices for the third time since the first of the year. Total drop has amounted to 60¢ per bbl.

MATTHEWS NUTYPE CONNECTORS



• ● •

BOLT AND CLAMPING JAW COLD FORGED FROM SAME MATERIAL AS YOUR COPPER CONDUCTORS, HENCE NO LOOSE CONNECTIONS DUE TO DIFFERENT COEFFICIENTS OF EXPANSION.

• ● •

HARD METAL NUT, 98% COPPER CONTENT, CLEAN, ACCURATELY MACHINED THREADS.

• ● •

FULL ENGAGEMENT OF THREADS AND CLOSE TOLERANCES OF ALL PARTS ASSURE STRENGTH.

• ● •

ALL CONNECTORS GIVEN 100% INSPECTION.

Nut retainers available on connectors for 6 solid wire to 1/0 strand inclusive.

Matthews Nutype Connectors provide strong, high pressure solderless connections free from electrical or mechanical troubles. The "V" shaped grooves in bolt and clamping jaw hold wires in proper alignment and prevent rocking and eventual loosening of wires. Flanged sides of clamping jaw give greater bearing surface on nut, hence greater strength and no distortion of clamping jaw. Large, strong bolt head with size plainly marked is designed with two flat sides for engagement of wrench or pliers. High copper content material of all parts prevents corrosion and season cracking. All edges are rounded so as not to nick wires. Connectors for 2/0 and larger wires are machined of strong, high copper content alloys.

Write for Bulletin 206 for complete information and attractive prices on all types of Matthews Connectors.

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ENGINEERS and MANUFACTURERS SINCE 1899

Sherman

Bond-Rod

Ground Clamps

Make Permanent Ground Connections

For many years the "Bond-Rod" Ground Clamp has been one of the most popular items in the Sherman line of Electrical Fittings.

Workmen like it, because it is easily and quickly installed — and makes a permanently dependable connection. Buyers like it because it is economically priced.

Get the facts about Sherman high quality Electrical Connectors. It PAYS! Write today for catalog showing the complete Sherman Electrical line.

H. B. Sherman Mfg. Co.
Battle Creek, Michigan

Sherman
ELECTRICAL FITTINGS

NEW ELECTRICAL CONSTRUCTION

A weekly selection of U. S. electrical construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is indicated or implied

UTILITIES

Proposed Construction

Arizona and Nevada—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Kingsman, Ariz., Saline and Prescott, Ariz., Earp, Calif., and Boulder City, Nev., transmitter-receiver sets and relays, carrier-frequency cable, etc. for Davis Power Plant, Parker Power Plant, Prescott substation, Hoover Power Plant, Basic Magnesium substation, 400 lin. ft. coaxial, carrier-frequency cable for Prescott substation for Davis Dam and Parker Dam Power Systems, Davis Dam Proj., Spec. 2699. Furnishing, del. f.o.b. cars shipping point or cars Yuma, Ariz., 2 power circuit breakers and outdoor disconnecting switches for Parker-Gila-Drop No. 4 Tap, Davis Dam Proj., Spec. 2695. Furnishing, del. f.o.b. cars shipping point or f.o.b. cars Coolidge, Ariz., automatic-voltage-regulating transformers, outdoor distribution transformers, outdoor disconnecting switches, outdoor current transformers, outdoor potential transformers for Coolidge substation, Davis Dam Proj., Spec. 2697. L. N. McClellan, ch. engr.

Colorado and Utah—Empire Electric Assn., Cortez, 153 mi. rural distr. lines, and sys. imprvs., Dolores and San Miguel Counties, Colorado, and San Juan Co., Utah. **$340,000.** John C. Leavitt, Garden City, Kan., consult. engr.

Del., Wilmington—Delaware Power & Light Co., 6 and Market Sts., plans by G. Morris Whiteside, 11 du Pont Bldg., office and service bldg. **$700,000.** United Engineers & Constructors, Inc., 1401 Arch St., Phila., Pa., consult. engr.

Nebraska—Dawson County Public Power Dist., Lexington, 408 mi. rural distr. lines, Sherman, Buffalo and Hall Counties. $400,000. Raymond H. Reed & Co., Columbus, engrs.

N. J., Trenton—U. S. Navy Dpt., Pub. Wks. Office, Phila. Naval Base, Phila., Pa., shop bldg. and pumping station, water supply, boiler house and boilers and fuel and water tanks at Naval Aeronautical Turbine Laboratory, NOY 18852. **$2,300,000.**

N. M., Albuquerque—U. S. Eng., P. O. Box 1538, reconstructing electrical distr. sys., (EOP-321-EOP-324), Sandia Base, Serial No. Eng-29-005-49-105.

N. M., Los Alamos—U. S. Atomic Energy Comn., Los Alamos, 1 story, part bsmnt., rein.-con. CMR-10 bldg., Inv. No. 291-49-150. Approx. $1,000,000. Plans deposit $50; 12 bldgs. and facilities in Technical Area 16, Inv. 291-49-151. $1,500,000-$2,500,000. Plans deposit $50.

N. C., Camp Lejeune (Br. New Bern)—Pub. Wks. Office, Bldg. No. 1005, Marine Barracks, underground and overhead 12,470 volt electrical power feeders and 999 kva. substation at Marine Barracks, Spec. 22815. Plans deposit $10.

O., Euclid—Lincoln Electric Co., 12818 Coit Rd., plans by Austin Co., 16112 Euclid Ave., Cleveland, 1 and 2 story brick, steel, concrete storage and administration facilities. **$9,000,000.**

Oregon—U. S. Eng., 628 Pittock Block, Portland, Zone 5, designing mfg., del. f.o.b. cars Gates, two 70,000 hp. hydraulic turbines, incl. embedded parts, appurtenances; two 55,000 kva. generator equip. for Detroit Dam Power Plant on North Santiam River near Detroit, Serial No. Eng-35-026-49-491.

Oregon—U. S. Eng., 19 E. Poplar St., Walla Walla, Wash., exten. 7,200-12,470 wyevolt, 3 phase, wire electrical distr. sys. at McNarry, Umatilla Co. Eng.-45-064-49-114.

Oregon—Bonneville Power Admin., 729 N. E. Oregon St., Portland, Zone 8, clearing right-of-way 10.3 mi. for Reedsport-Lakeside sect. of Reedsport-Coos Bay 115 kv. transmission line, Douglas Co., Inv. 1678. Plans depos't $5.

Texas—Floyd Co. Rural Electric Cooperative, Floydada, 86 mi. rural distr. lines, 9.7 mi. 66 KV transmission lines, sys. imprvs., Floyd Co. **$685,000.**

Texas—Concho Valley Electric Co-operative, Inc., San Angelo, 150 mi. rural distr. lines, Concho, Tom Green, Nolan, Coke, Sterling and Mitchell Counties. $165,000. Plans deposit $15. Freese & Nichols, 407 Danciger Bldg., Fort Worth, engrs.

Virginia—Virginia Electric Co-operative, Bowling Green, 4 sub-stations, in Caroline, Louis and Essex Counties. Plans deposit $25. C. W. Hylton, Bowling Green, engr.

Washington—Bonneville Power Admin., 729 N. E. Oregon St., Portland 8, Ore., constructing Naselle Substation, near Naselle, Pacific Co., Inv. 4683. Plans deposit $25.

Washington—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing and del. f.o.b. cars shipping point or f.o.b. cars at Quincy, out-door transformer, station type lighting arresters, outdoor horn-gap switch, outdoor-type disconnecting fuses, each with 2 fuse units for Quincy Pumping Plant switchyard, Columbia Basin Proj. Spec. 2696. L. N. McClellan, ch. engr.

Washington—Bureau Reclamation, Dpt. Interior, Cody, Boysen-Thermopolis 115 kv. transmission line, Missouri River Basin Proj. Spec. 2693.

Low Bidders & Contracts Awarded

Arizona and Nevada—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., May 24, Schedule (1), substation for Electric Dist. 2 substation and Schedule (2), substation of Electric District 4 substation, both Davis Dam Proj., Spec. 2628, from Allis-Chalmers Mfg. Co., Continental Oil Bldg., Denver, Colo., **$166,544** and **$166,544** respectively.

Iowa—Corn Belt Power Co-operative, Humboldt, 296 mi. 68 KV rural distr. lines, Palo Alto, Kossuth, Hancock, Floyd, Chickasaw, Bremer, Butler, Humboldt, Pocahontas, Buena Vista, Sac, Calhoun, Webster, Hamilton and Hardin Counties, to Walco Eng. & Constr. Co., 2408 E. 4 Pl., Tulsa, Okla., **$1,117,328.** Bids 5/10.

Texas—U. S. Eng., 606 Santa Fe Bldg., Galveston, May 11, furnishing, del. three 10,000-12,500 kva. single phase transformers, appurtenances, Whitney Dam Power Plant on Brazos River, near Hillsboro, Hill Co., Eng-41-243-49-257, from The Standard Transformer Co., Warren, O. **$96,144.**

Tex., Longview—Southwestern Gas & Electric Co., 428 Travis St., Shreveport, La., power plant to Austin Bldg. Co., Longview. **$4,750,000.** A. B. McIver, c/o owner, engr.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Conn., Hartford—Hartford Housing Auth., 846 Asylum Ave., housing, fifty-nine (410 apartment) bldgs., Proj. MR-17. $3,500,000. Plans deposit $100. Kane & Fairchild, 49 Pearl St., archts.

Ill., Chicago—Cook Co., County Bldg., 15 story, steel, brick dormitory, concrete slab floors, in West Side Medical Center, 720 S. Wolcott St. $7,000,000. Raymond J. Houlihan, 30 N. Dearborn St., archt.

Me., Augusta—State of Maine, Dpt. P. Bldg., State House, Augusta, plans by Miller & Beal, Inc., 465 Congress St., Portland, and Desmond & Lord, 6 Beacon St., Boston, 3 story, bsmnt., brick, stone, concrete state house addn., Grove, Capitol and Jackson Sts. Approx. **$3,000,000.**

N. Y., Rome—Bd. Educ., N. George St., Junior High and Elementary School, $3,000,000. Plans deposit $100. Starrett, Van Vleck & Reginald Marsh, 101 Park Ave., New York, Zone 17, archts.

RECENT RATE CHANGES

Tide Water Power Co. Wilmington, N. C., has filed application with the State Utilities Commission for an increase in electric rates. President W. W. Bell said the over-all average increase asked for would be about 7%. It would mean about one cent a day increase for the individual customer. The increase would not affect industrial rates.

Georgia Power Co and the **Georgia Power & Light Co** have completed an agreement whereby Georgia Power will sell energy to Georgia Power & Light. GP&L will then resell the power to REA co-ops and municipalities in its territory. Under the contract filed with the Georgia Public Service Commission, Georgia Power will sell energy at 6.5 mills per kwhr. GP&L will make a slight markup on its price to the co-ops and municipalities. The co-ops will save about 1/4¢ per kwhr.

Eastern Nebraska Public Power District has advanced electric rates to about 5,000 rural customers. The increase raises costs a maximum of $1.20 a month for users of 200 kwhr or more a month. H. D. Miller, manager, said the rate increase was made necessary because of the large increases in cost "all along the line."

Pacific Power & Light Co. has filed with the Oregon State Public Utilities Commissioner new lower rate schedules for The Dalles, Ore., and vicinity. The new rates would be equivalent to those charged by the Northern Wasco PUD, which has recently entered the field in competition with PP&L. The proposed new rates would mean a saving of approximately $70,000 annually. Decision on the petition of Pacific Power & Light hinges on whether the proposed reduction would burden consumers in other areas, according to E. L. Graham, assistant state attorney general, who served as examiner for the state Public Service Commission at the hearing. Will T. Neill, vice-president of the company, testified his company would be forced out of The Dalles unless allowed to meet PUD rates. He denied charges made by representatives of the State Grange that the reduced rates would force PP&L customers elsewhere to pay the difference.

Kentucky & West Virginia Power Co. Ashland, Ky., has asked the Kentucky Public Service Commission for a $306,000 rate increase on energy to industrial customers. In 1946 Kentucky & West Virginia lowered its rates by $368,350. Industrial consumers benefited by that reduction by $216,750, Clifford E. Smith, counsel for the company, said. The utility, he said, now wants to restore its industrial rate to the pre-1946 level. G. South Dunn, public relations director of the company, stated that the utility has an $8,000,000 improvement-expansion program under way at the present time.

Eastern Light & Power Co and the **Dominion Utilities Corp** have been authorized by the Nova Scotia Public Utilities Board to increase rates, the former 6%, and the latter 10%. Both utilities distribute energy supplied by the Seaboard Power Corp. Sydney and Glace Bay.

Clarksville (Ark.) City Council has approved reduction of electric rates, effective with April bills. The electric rates for domestic customers will be reduced from 2¢ to 1½¢ per kwhr for all over 15 kwhr. Leslie Bryant, chairman of the Light and Water Commission, said the new rate will permit residents to install deep-freeze units, electric ranges, electric water heaters, and other appliances at a negligible extra cost.

Interstate Light & Power Co. Galena, Ill., has been authorized by the state Commerce Commission to increase electric rates approximately 2½% in Galena and Menominee.

Elizabeth Light & Power Co. Galena, Ill., which is controlled by Interstate Light & Power, has been authorized to increase electric rates approximately 9% in the territory it serves south and east of Galena.

•

ASA Establishes Three New Standard Sizes

With the adoption of three standard sizes—one for pamphlets, one for books, and one for pocket-sized books—the American Standards Association has acted to bring about greater uniformity in the size of American Standards. At present, American Standards are published in some 20 different sizes by the many national organizations that are active in the standardization program.

The three sizes now adopted by ASA are 8½ x 11 in. for pamphlets; 6 x 9 in. for books; and 5¼ x 7¾ in. for pocket-size books.

Henceforth the majority of American Standards published by the ASA itself will be 8½ x 11 in., the pamphlet size. This size has been adopted on the basis of a questionnaire answered by a large percentage of the primary users of American Standards. The replies indicated that use of the 8½ x 11 in. size would make it convenient for business and industry to incorporate American Standards directly into their own books of standards and to combine them directly with correspondence, proposals, and drawings without having to reproduce them in a different size.

The standard 6 x 9 in. size for those American Standards published in book form was chosen as the size most easily used on desks and bookshelves. It also follows the practice of many of the organizations which publish compilations of nationally recognized standards.

The 5¼ x 7¾ in pocket size, although not widely used, is considered to be valuable in a few special cases.

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Picture Going Abroad

National Carbon Co. Inc. New York, has announced that its motion picture, "Carbon Arc Projection," color by Technicolor, has been selected by the Office of International Information, Department of State, for distribution throughout 52 foreign countries.

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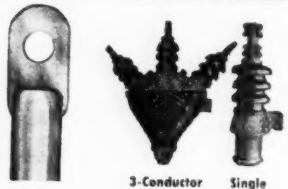

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● MAGNETS: A wide variety of cast and sintered Alnico magnets, as well as special magnetic alloys, are listed in a 28-page catalog (CDM-2A). The catalog has pull curves of many stocked magnets, and includes drawings of all stocked patterns. General Electric Co, Chemical Department, Pittsfield, Mass.

● DISTRIBUTION SYSTEMS: Detailed information about industrial plant distribution systems is given in a 32-page booklet. Colored diagrams of 11 basic distribution systems, descriptions of the operating principles of the systems, and numerous photographs of installations are included. Westinghouse Electric Corp, P. O. Box 868, Pittsburgh, Pa.

● THERMOCOUPLES: Containing 56 pages of detailed information on thermocouples, protection tubes, and other pyrometer accessories, Bulletin No. P1238 carries tables of calibration data for the commonly used base-metal and rare-metal thermocouples. A technical section, described as the "Users' Manual," gives engineering handbook data on factors affecting thermocouple life, corrosion and poisoning, thermocouple reproducibility, thermocouple insulation, etc. The catalog section, described as the "Buyers' Guide," is indexed and illustrated. The Bristol Co, Waterbury 91, Conn.

● BLOWERS: In Bulletin 22-23-B-13 on rotary positive blowers operating advantages and principles are discussed, accompanied by several performance curves under various operating conditions. Roots-Connersville Blower Corp, 900 West Mount St, Connersville, Ind.

● GENERATORS: Switchboardless generators, their operating principles and advantages, are discussed in a two-page illustrated leaflet. Kato Engineering Co, Mankato, Minn.

● TURBOPUMPS: Bulletin "S" describes Type CC and CG single-stage turbopumps and includes illustration of the pump, running gear, governor detail, also pictures of other pumps, notably Types "F" and "G" and "B" and "BL". The J. S. Coffin, Jr. Co, 326 So. Dean St, Englewood, N. J.

● VALVES: Various types of cast steel pressure-seal bonnet valves are described in Catalog 12-H. These valves are of new flow design, in stop, non-return, and check types, with chromium-molybdenum steel bodies and welding ends for services of 900, 1500 and 2500 lb sp at 1000F. A new method for correlation of valve size and pressure drop is also included. Edward Valves, Inc, East Chicago, Ind.

● ELECTRICAL HEATING: Outlining the engineering principles involved in simple terms, a technical folder on electrical resistance heating elements describes the manufacturing processes, the various types, and several specific applications. Safeway Heat Elements, Inc, 76 Water St, Middletown, Conn.

● TRANSFORMERS: Bulletin 55 describes the Transformer Turn Ratio Test Set, used for measuring turn ratio in power transformers. This portable device also checks polarity, tap changer defects and problems of load division and circulating currents. James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

● POLE LINE SPECIALTIES: A 16-page bulletin contains detailed data on a line of pole line specialties, including guy anchors, telehelghts, slack pullers, wire clips, telefaults, connectors, guy guards and wire reels. W. N. Matthews Corp, 3850 Delor St, St Louis 16, Mo.

● OVENS: In an eight-page bulletin, extensively illustrated, infrared ovens are described in detail, with emphasis placed on the speedy and economical drying, baking and preheating qualities. Some industrial applications of the infrared process are cited. Triangle Equipment Co, Inc, 45 River Road, Nutley, N. J.

● MOTORS: Brakemotor bulletin, B 501 describes with technical data, the construction and operation of these integral brakemotors, individually designed for powering specific equipment, such applications ranging from high speed bottling and molding machinery to cranes and hoists. Star Electric Motor Co, 200 Bloomfield Ave, Bloomfield, N. J.

● CONTROLS: By means of diagrams and illustrations, Catalog 700 presents the operating features of automatic transfer switches, remote control switches, contactors, relays and specialized controls. Automatic Switch Co, 391 Lakeside Ave, Orange, N. J.

● DYNAMOMETERS: Bulletin D describes this instrument used for measuring traction, tension, or weight from 0-500 lb to 0-20,000 lb with the closest accuracy. It operates through deflection of a special alloy steel beam, and requires only 0.040-in. movement to indicate a full scale reading. The bulletin shows the instrument's use in the power and communications fields. W. C. Dillon & Co, Inc, 5410 W Harrison St, Chicago 44, Ill.

● INSTRUMENTS: Complete line of Speedomax instruments—indicators, indicating recorders, and recording controllers—is described and illustrated in a 44-page catalog. Called "Speedomax Type G Instruments", the catalog ND46(1) illustrates design features; schematic diagrams of the Speedomax potentiometer and Wheatstone bridge circuit; and full-size, full-color sections of a round chart and a strip-chart, with the type of record available for each. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

● BATTERIES: In bulletin B221, a new single-circuit battery charger for battery-powered industrial trucks is described. The illustrations in this four-page bulletin reveal the outstanding features and operating details. The Electric Products Co, 1725 Clarkstone Road, Cleveland 12, Ohio.

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Primary Network System

(Continued from page 84)

provide the parallel operated regulating equipment with a drooping characteristic. In general it appears that a primary network system will be somewhat more difficult to operate than a radial system because of these loading and regulating problems.

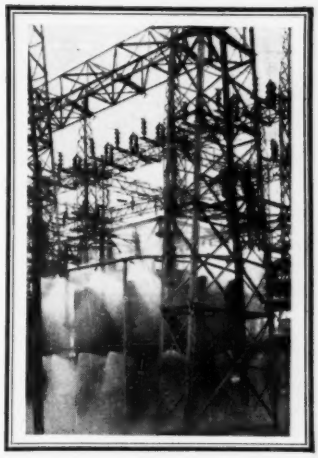
Less than Three Networks per Year

It is difficult to keep an accurate check on all primary network systems because existing equipment may be modified and used in a primary network, or primary network equipment may be purchased and operated radially for many years. Since 1933, when there were five primary network systems in operation, the number of companies operating primary networks has increased to at least 20. Twenty other companies have purchased primary network substations which may eventually be used in primary network systems.

In April 1931 the writer made the following statement. "It is a bit early to attempt to prophesy as to the future of the primary network system, but I feel that it will either come into pretty general use or lead to the development of a radial type of system cheaper than the network system or present day radial systems."

During the more than 17 years since that statement was made the primary network system has not come into general use. The reasons are: (1) The primary network system does not provide appreciably higher quality service than radial systems costing about the same or less, and (2) it is somewhat more complicated to design and operate.

Nevertheless, the primary network system has had a very marked influence on the art of distributing electric power. It has been responsible for the development of the small bus-regulated factory-built substation, and also led to the development of cheaper and more flexible radial systems using small, simple, bus-regulated substations. Today the primary network system should be used in those urban and suburban areas where it will do the job cheaper than a modern radial system. However, a modern radial system will, in the writer's opinion, usually prove to be the cheaper and more easily operated system.



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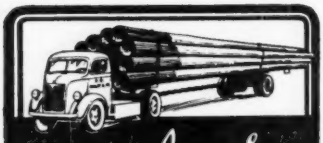

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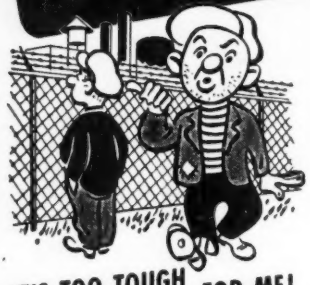

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BOOK REVIEWS

Design for Welding. Published by The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio. 1,020 pages, illustrated. Price, $2.00 in U. S., $2.50 foreign.

Content is abstracts of 82 winning papers in a "Design for Progress" competition recently sponsored by the Foundation. Papers included are in the categories: Aircraft, Automotive, Railroad, Watercraft, Containers, Furniture, Structures, Machinery, and Welderies. The machinery and structures sections are especially good and represent well the advances in welding techniques in these fields. Profuse illustrations —photographs, drawings, and tables of cost and other data—add much to the value of the book.

Waveforms. By Britton Chance et al. Published by McGraw-Hill Book Co, New York 18. 785 pages illustrated. Price $10.

Circuit designers charged with carrying out a timing, computation, or measurement operation will find here how they can choose a circuit to achieve the objectives. The book first surveys the properties of linear and non-linear circuits and then analyses mathematically and experimentally the circuit techniques involving precisely controlled voltages and currents of various waveforms. While the information was compiled by collaborators in the MIT radiation laboratory the subject matter is not addressed exclusively nor even dominantly to the needs of radar. The circuits are, however, dominantly electronic.

The Electric-lamp Industry. By A. A. Bright, Jr. Published by the Macmillan Co, N. Y. 526 pages, illustrated. Price $7.50.

One of the MIT "studies of innovations", this book conforms to the general aims of the series to present the factors which have influenced the direction, extent and timing of technological advances upon which industry has expanded. It puts together the scientific genesis of the various lamps, the corporations erected to exploit them and the merger and licensing moves they made to protect and enlarge their positions. For the student of economics and the evolution of private enterprise there is plenty of nourishment. For the lighting engineer there is an equal content of history and background upon which rest today the eminence of the incandescent filament lamp and the ascendency of the fluorescent. For both it is rich with well-documented episodes that make the recital mildly romantic, yet far from critical of motivation.

Electric and Diesel-electric Locomotives. By D. W. and M. Hinde. Published by the Macmillan Co, New York. 366 pages, illustrated. Price $9.25.

This British-authored book takes ample notice of U.S.A. practices and equipments in its study of both types of locomotive. The electrified-system units are treated in all three common forms—d-c, a-c, and converter; there is discussion of the motors, the controls, the auxiliaries and braking for each type. Details are likewise given about the international diesel engines. A comprehensive tabulation (90 pages) lists details of over 500 locomotives of which some 25 are those used on American railroads, the rest being on the other continents as well as the British Isles.

Theory of Oscillations. By A. A. Andronow and C. E. Chaikin. Published by Princeton University Press, Princeton, N. J. 358 pages illustrated. Price $6.

The implementation of the theory of harmonic oscillations is admittedly much more complete than that for non-linear oscillations. Phenomena of nature are prolific, however, in non-linear manifestations and this is what prompted the Russian authors to extend the tooling in that direction. Emphasis by them (carried over into the adaptation in the present English translation) is on the self-excited oscillations and their proneness to stability or instability. The approach and the conclusions are dominantly mathematical, reference to representative problems being only occasional to establish a point of departure. Vacuum tube circuits are the most numerous exemplifications.

Public Organization of Electric Power. By John Bauer, Ph.D. and Peter Costello.

This book outwardly advocates the replacement of private power system, with public systems mixed up by Federal supply, state systems, co-ops, municipals and Public Utility Districts.

The reasons are based upon unsubstantiated estimates, inaccurate assumptions, and obsolete data. To justify their position, the authors claim an overcapitalism of the electric power industry which does not exist. They show a gain in favor of public power by using federal financing, and doing away with income taxes and sales expenses of private systems.

Electronic Time Measurements. Britton Chance et al. Published by McGraw-Hill Book Co, Inc, New York 18. 538 pages, illustrated. Price $7.

Another in the concluding MIT Radiation Laboratory Series this book has its objectives the field of time and distance measurements (either manual or automatic) and the circuit arrangement. Most of the emphasis is on radar techniques and the treatment presupposes an understanding of PPI, Shoran, Loran etc, as developed in other volumes in the series. The schemes devised for precisioning and automatic recording should intrigue the power engineer bent on expanding his grasp and use of electronic tooling.

Photoelectricity and its Application. By V. K. Zworykin and E. C. Ramberg. Published by John Wiley & Sons Inc, New York 16, N. Y. 494 pages, illustrated. Price $7.50.

In superseding "Photocells and Their Application" the authors have modernized the scope by incorporating all the developments since 1934. Half the text is devoted to theory but the mathematics is subordinated to principles and idea development. This portion is replete with charted and tabulated characteristes. The second half deals with the techniques of such typical phototube and photocell applications as measurement, picture transmission, television illumination control, hot-body detection, traffic control, automatic inspection. Extensive bibliographies with each chapter afford broad access in case the terse but illuminating details in the text are not sufficient.

TECHNICAL LITERATURE

Manometers—"A Recommended Practice, RP2.1, Manometer Tables," presents abbreviations and fundamental conversion factors, recommended definitions of pressure in terms of a column of mercury and water, and for a large number of liquids, tables of pressures indicated by, or equivalent to, heights of columns at various temperatures. The 32-page publication is available, at $2 to nonmembers, from Instrument Society of America, 1117 Wolfendale St, Pittsburgh 12, Pa.

Instruments—"Electrical Indicating Instruments. Part I. Panel and Switchboard Instruments" which is American Standard C 39.1—1949 has been issued. This successor to the wartime C 39.2 of 1943 places on individual sheets the pertinent detailed requirements against each size and kind of instrument. One is generally interested in a certain size and kind of instrument on a given occasion and this arrangement averts checking through many pages for the details applying to that particular item. Rather than attempt to cover portable instruments the standard was brought to an interim completion on panel and switchboard instruments. The standard as issued, Part I, C 39.1—1949, will be a most useful tool for all concerned with both the manufacturer and the use of panel and switchboard instruments. Basic definitions have been improved; definitions have been added. The term "sensitivity" has been completely omitted in favor of "loss" as descriptive of the energy taken to operate the instrument. Instrument accuracy for nonlinear scales has been clarified. Obtainable from American Standards Association, 70 East 45th St, New York 17, N. Y.

Indicating Instrument—"American Standard for Electrical Indicating Instruments," C 39.1-1949, covers only panel and switchboard instruments. An important contribution is the addition of many new definitions. The text includes general requirements and test requirements for temperature, effect of overload, shock, vibration, humidity and dielectric test. Copies of the publication may be obtained from the American Standards Association, 70 East 45th St, New York 17, N. Y. at $1.50 per copy.

Lighting—"Cold Cathode Fluorescent Lighting" gives technical data on cold cathode lamps. What the cold cathode lamp is, how it is used, and an explanation of auxiliary equipment are the general subjects covered. Publication 10, a 5½ x 8-in. manual, has been issued by Fluorescent Lighting Association, 501 Fifth Ave, New York 17, N. Y.

Pump Selector—Arranged as a slide rule, the Monitor pump selector offers a solution to finding the capacity for a farmer's well and the required motor horsepower. The pocket device has been made available by Baker Mfg Co, Evansville, Wis.

Photography—"High-Speed Photography" is a 129-page booklet consisting of symposium papers and issued by Society of Motion Picture Engineers, 342 Madison Ave, New York 17, N. Y., at $1.50 per copy. Some specific topics include electrical flash photography, new high-speed stroboscope, motion picture equipment and lamps for high-speed photography.

Magnetic Amplifiers—Bulletin VT-2006 is devoted to an elementary description of a magnetic amplifier which is similar to a saturable reactor. Circuits, applications, characteristics and developments are presented in the 28-page publication available from Vickers Electric Div, Vickers Inc, 1815 Locust St, St. Louis 3, Mo.

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LETTERS TO THE EDITOR

U S Engineers Praised

To the Editor of ELECTRICAL WORLD:

No doubt you heard or have seen the amazing tribute paid by Winston Churchill to the American engineer in his address at the Boston Garden last week during the Mid-Century Convocation at M.I.T. In his opening paragraph he said:

"We have suffered in Great Britain by the lack of colleges of university rank in which engineering and the allied subjects are taught. Industrial production depends on technology and it is because the Americans, like the pre-war Germans, have realized this and created institutions for the advanced training of large numbers of high-grade engineers to translate the advances of pure science into industrial technique, it is for this reason that their output per head and consequent standard of life are so high."

He might have added that for the same reason this country was the first to produce enough fissionable material to create an atomic bomb.

In view of the aspersions which have been cast on the American engineer's "inadequate training" in this post-war period, I would suppose that the remarks of this most competent observer would warrant quotation in ELECTRICAL WORLD.

W. F. Ryan
Stone & Webster Engineering Corp
Boston, Mass.

Federal Spending

To the Editor of ELECTRICAL WORLD:

Your letter of April 27th is appreciated, referring to my critical comments of April 13th. Rest assured that any comments I may make on public policy may be used freely in or out of context by any person who shares my abhorrence of current public spending policies.

I should, perhaps, explain my reason for the critical attitude which I recently explained by 'phone to your Chicago Editor. Any comments I may make as an informed layman should possess greater value than those of a public utility satellite. As I pointed out to Senator Douglas a month ago in Washington, my expertness on certain phases of the public utility problem is unquestioned. But, I have not worked for any utility for over 11 years and therefore have no strings attached. From this vantage point, I am unequivocal in my advice to Congressmen: Don't take the advice of professional spenders on power policy; weigh it against the opinion of the utility industry.

Humor was attempted in my reference to a "sanitary WPA privy in every back yard." The humor is not apparent when the U S Senate horse-trades on a $12.5 million "outhouse fund" to provide this facility, or amenity, on submarginal farms. ("Time" May 2nd 1949.) Perhaps I am bitter on this because I was brought up on a farm which today's do-gooders would class as submarginal. In those days we could always find a board, a saw and a jackknife without financial aid from Washington.

Also, if you have not seen the year-old letter to Representative Vursell, you may be interested in it.

E. F. Downs
Chicago, Ill.

Bare Wire Arcs

To the Editor of ELECTRICAL WORLD:

Technical Notes, page 20, March 19, 1949, "Bare Wire" contains the following item:

"Bare wire offers an advantage for primary conductor use in that any arc will travel along it and render it less likely to burn down than weatherproof wire."

Len Carter of our staff, in calling my attention to this item, writes as follows:

"An electric arc will travel along a bare wire if the wind and magnetic effects are right but will not move away from a point of support so readily. Most arc-overs occur at points of support. The wire will usually burn 20-50% of its cross section (a movie showed 2, 3, and 4 strands burned away), thus leaving a damaged wire which breaks with mechanical working or in the next sleet storm.

"Weatherproof-covered conductors do not develop short circuits or arcs in more than 90% of the cases of contact (really good weatherproof of the vintage since 1932 has a still better record).

"The burn-off of bare wire in the movie, as a result of dropping limbs across two wires, was not the result of dropping limbs at all but was started by cutting the covering and using a fine wire between the two line wires.

"Covered wire has the advantage over bare wire for primary conductors of the class referred to in Technical Notes and in the movie shown recently

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to an AIEE committee. in that more than 90% of the contacts would not result in arcs and those that did would burn the line down requiring immediate repairs, not add another incipient break.

"The number of damaged bare wires and bare stranded wires is becoming an increasing problem and a mpts are being made to work out methods for locating these burns by inspection. It would cost less to use weatherproof and burn it down in a few cases.

"Also, there is considerable loose conversation about wind and sleet loadings on bare wire or thin-covered wire versus weatherproof, that might be of interest."

Better stick to "volcanoes, fumaroles and lagonis" if you don't want to start an agrument.

L. F. Hickernell
Chief Engineer
Anaconda Wire & Cable Co

Of comparable interest could be the last paragraph on page 94 of "Coordination of Distribution Protection" by Chase Hutchinson in the March 26, 1949 issue. In it appears this ". . . for a given fault arc current weatherproof wire burns down quicker than bare wire."—Editors

Invisible Balance Sheet

To the Editor of ELECTRICAL WORLD

Congratulations for reprinting in your issue for February 26, 1949, that fine article by Mr. Warren R. Voorhis, "The Invisible Balance Sheet." We humans tend too easily to reduce realities to symbols, the better to toss them about in conversation, or compress them into statistics. It is well to be reminded of the poignancy, color and feeling we miss when we confuse the symbols with the realities themselves.

As Mr. Voorhis properly suggests, the invisible balance sheet, some examples of which he describes, need not balance, and therein is a sort of self-contradiction. Not that it matters. Perhaps if the word "balance" were deleted the title to the article might more accurately reflect its message. Alas, the poverty of language and symbols. A discussion entitled "The Invisible Sheet" would look like it belonged in a detective story magazine.

C. W. King
Securities and Exchange Commission
Washington, D. C.

P.S. While the writer is an attorney on the staff of the Securities and Exchange Commission, you will appreciate that the foregoing are my own personal views, and not necessarily those of the Commission.

C. W. King

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WANTED SALES Engineer Insulated Wire and Cable Company, 30 to 40 years old, give complete information first letter. P-8924, Electrical World.

POSITIONS VACANT

ELECTRICAL ENGINEER experienced in electrical design for steam-electric generating plants. Graduate electrical engineer, with mature experience, preferred. Must be capable of handling engineering, design and specifications for all electrical equipment and wiring for a new power plant, as well as outgoing 13,800 volt transmission lines and substations. Salary commensurate with qualifications and experience. Location, Baton Rouge, La. P-9200, Electrical World.

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POSITIONS WANTED

ELECTRICAL ENGINEERING graduate, May 1949, Missouri School of Mines and Metallurgy. Interested in electrical equipment manufacturing. 2½ years machine shop inspection experience. Age 25, single, veteran. PW-8644, Electrical World.

ELECTRICAL ENGINEER, age 42, 20 yrs. experience in design, Supervision of Construction, Operation & Maintenance, with specialized study in relay & control installations & operation desires position with reliable Industrial or Utility as Supt. of Construction & Maintenance. Will locate anywhere. PW-9124, Electrical World.

ELECTRICAL ENGINEER, 29, both M.E. & E.E. degree, Westinghouse Test Course, employment for one year; 4 years diversified experience: design, construction, maintenance of hydro-diesel plants, transmission, distribution, management; sales, industrial, project engineer. Executive ability. Speak English, Spanish. Prefer S.A., C.A.e or Caribbean—Available June 30. Address: J. R. Saborio M., Alajvela, Costa Rica, C.A.

(Continued on opposite page)

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ELECTRICAL ENGINEER, age 51, with 25 years of wide experience on Layout and Designing of Plant equipments, Industrial Plants, Power Plants, Sub-stations, Switch-boards, Automatic Controls, Power, Lighting and Distribution. PW-9206, Electrical World.

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U. S. Government

UNITED STATES DEPARTMENT OF INTERIOR, Bureau of Reclamation. Sealed Bids (Specifications No. 2695) will be received by Bureau of Reclamation, Denver, Colorado, July 14, 1949, and then publicly opened for furnishing two 161-kv, 1,200-ampere, 3,500,000-kva power circuit breakers and four 161-kv, 600-ampere, 3-pole disconnecting switches, for Parker-Gila-Drop No. 4 Tap transmission line, Davis Dam Project, Arizona-Nevada. Delivery is desired within 300-400 days. For particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado. MICHAEL W. STRAUS, Commissioner.

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H.P.	Make	Type	Volts	Speed
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750	G.E.	5094-7 KF-	2300	1800
500	G.E.	KTP	440	1800
350	West.	CS	2200	900
250	G.E.	DK	2200	900
200	West.	CS	400	720
150	G.E.	TEFC	550	720
100	Al. Ch.	AR	440	514
100	Al. Ch.	AR-8B	2200	1200
750	G.E.	DK	440	720
75	Al. Ch.	AN	440	1200
60	Al. Ch.	AR	440	514
50	West.	CS	2200	900
30	G.E.	KT	440	900
25	Cr.Wh.	11SQ	220	1200

SLIPRING MOTORS

3000	G.E.	IM	2200	120
1000	Al. Ch.	ANY	2300	240
800	West.	CW 6600/	440	507
750	G.E.	MT-16	2200	450
500	Ideal	AY 2200/	4000	1800
400	Al. Ch.	ANY	4000	514
350	G.E.	IP	2300	720
300	Al. Ch.	ANY	2300	720
250	Cr. Wh.		440	600
125	G.E.	IM	2300	720
100	Al. Ch.	ANY	440	720
60	West.	CW	2300	870
30	Lincoln	Crane	440	900
15	Al. Ch.	ARY	440	900
11	West.	CW	440	1100
7½	G.E.	ITC	440	1200

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1000	West.		2300	900
800	Cr. Wh.		440	300
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450	E.M.		440	240
250	Al. Ch.		2300/4000	720
200	Al. Ch.	PF-100	2300/ 440	360
150	Cr. Wh.		220	720
145	G.E.	ATI	440	900
125	G.E.	TS	440	600
100	G.E.	ATB	2300	900
100	G.E.	ATI	2200	1500
75	G.E.	ATI	220	900
60	G.E.	TS	220	1200
20	Flynn-Wy	15-VRN	440	1200
15	Century		440	1200

D.C. MOTORS—110 VOLTS

H.P.	Make	Type	Speed
125	G.E.	RC-28A	500
55	G.E.	DLC-203A	1000
25	G.E.	RC-32	800
25	Cr. Wh.	CM-251	750
7½	Rel.	REB	1200
5	Sturv.		570
5	G.E.	RC-7	1150
5	G.E.	BC-23B	3450
3	G.E.	B-224	3500
2	G.E.	CVC-111	1100
2	G.E.	RC-25	1150
2	G.E.		1400
2	G.E.	RC-22	3450
2	G.E.	RC	3450
1½	Diehl	C-305	400
1½	Watson	BW-3	550
1½	West.	SK-224	1150
1½	West.	D	1725
1	Diehl	16	475
1	Elec. M.	E	2500

ADJUSTABLE SPEED D.C.—110 VOLT

H.P.	Make	Type	Speed
60	Sprague	C	500/1500
30	West.	E	615/1230
20	Roth		685/1165
10	G.E.	RC	575/1150
10	N.W.		600/1200
4½	Cr.Wh.	CM-1q1F	580/1740
½	Roth		350/1400

ADJUSTABLE SPEED D.C.—230 VOLT

H.P.	Make	Type	Speed
500	G.E.	MPC	165/330
250	ELD		400/1200
180-230	G.E.	MPC	730/980
175-350	G.E.	MPC	400/800
100	D.C.	Dyn.	200/3500
75	West.	SK	350/450
35	G.E.	C	300/900
30	West.	SA	400/1200
30	G.E.	SP	240/700
30	Sprague	C-60	240/300
30	Tri.	JF	230/750
25	G.E.	RC-16	500/700
25	G.E.	DLC	600/1000
25	G.E.	RC	500/700
25	West.	S-9	360/780
15	G.E.	LC	550/1000
15	G.E.	RC-16	500/700
10	West.	SK-109	400/1600

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2—750 K.W G.E. condensing, 3600 250 lbs. Surface condenser, 3 ph. 60 cyc. 440v. dir. conn. exciters

1—300 K.W. G.E. non-condensing 175 lbs., 5/15 lbs. B.P. 3 ph., 60 cyc., 480 v. Dir. conn. exciter

1—1000 KW. G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine

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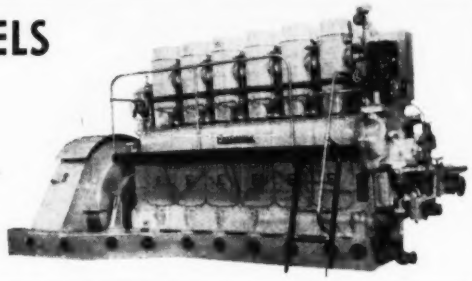

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900	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Superior	OS	750	327	125	General Motors	3-268A	150	1200
425	Baldwin	VO-6	510	450	75	General Motors	6016-E	90	1200
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1—75 HP. General Electric Type KT 900 RPM 440 volt.
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1—2500 HP G.E. MT 257 RPM 6600 volt
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60 HP. West. 900 rpm 2200v, 60 cy. Vert.
50 HP. F.&M. 1800 rpm 220v, 60 cy.

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1—125 HP. G.E. 1800 rpm R.C.
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1—125 KW. Crocker Wheeler 1200 rpm 125v Generator 2200v S.C. Motor.
1—100 KW. Elect. Mach. 1200 rpm 125v Generator 4150 Syn. Motor.

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1—3000 Amp. Chandeysson, 6/12v 400 rpm 8yn Motor.
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1—1000 KVA G.E. 3 ph. 4150 volt to 2400 volt
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3—300 KVA Pitts. 2300v pri. 115/230v sec.
3—300 KVA G.E. type H 2300v pri. 115.230v sec.
3—150 KVA West. 2300 volt Pri. 240/480 sec.
1—150 KVA G.E. 2300v 110-220v.
3—100 KVA GE 4150v, 240/480v. Pyranol
3—100 KVA G.E. 4150 v 230/460 v Pyranol
3—75 KVA Amer. 2400v. pri. 240/480 sec.
6—50 KVA West. 2300 v. 120/240 v. Interleave

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1—2500 KVA Westinghouse, Syn. condenser, 720 rpm 2200v with D.C. exciter.
1—320 KVA Allis Chalmers, 450 rpm 480v.
1—240 KVA General Electric ATB, 600 rpm 240v with D.C. exciter.
1—225 KVA 514 rpm 600v Westinghouse.
4—200/100 HP. Whse. 720/360 rpm 4150v.
1—200 HP General Electric 257 RPM 440 volt.
1—100 HP. G.E. type TS 600 rpm 4400v D.C.
2—150 HP. Allis Chalmers, 360 RPM, 2200 volt

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D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	2000	Whse.		600	600/720
1	1750	Whse.		600	550/700
3	1500	Whse.		525	600
1	1200	Whse.		600	525/700
1	700	G.E.	MCF	600	150/525
1	650	G.E.	MPC	250	115/145
1	600	Whse.		600	800/950
2	600	G.E.	MPC	600	600/720
1	335	Whse.	MQ	250	300/900
1	200/300	G.E.	MPC	220	360/920
1	275	Whse.	QM-600.6	230	425/850
1	260	G.E.	MPC	230	400/500
1	230	Al. Ch.		230	700
3	150	Whse.	8K-200	230	600
1	150	Cr. Wh.	CMC-68H	230	1150
1	150	G.E.	MPC	230	230/450
1	150	Cr. Wh.	152HL	230	300/1050
2	150	Cr. Wh.	TEFC-87H	230	890
1	150	G.E.	CD-B-Brg.	600	250/750
3	125	G.E.	CO	230	625
1	125	El. Dy.	308	230	750/1560
1	115	Cr. Wh.	JHL	230	1200
1	100	G.E.	CD-175	230	365/730
1	100	G.E.	MPC	230	225/450
2	100	Whse.	8K-Vert.	230	485/950
3	100	Rel.	1050T	230	400/1200
1	80	El. Dy.	308	230	475/950
8	75	Cr. Wh.	53H-TEFC	230	860
1	75	Whse	8K-180	125	650
2	75	G.E.	CDM-1126Y	230	2000

TURBO GENERATOR SETS

See ad on page 581

SYNCHRONOUS CONDENSERS

Qu	KVA	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4150	900
1	3000	Whse.		2400	720

MOTOR GENERATOR SETS

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	DC Volts	AC Volts
1	2000/30	Whse.	720	600	2300
1	1500	G.E.	360	275	2200/4400
1	1500	G.E.	600	600	4150
1	1500	Whse	600	600	4150
1	1250	G.E.	600	275	2300/4150
1	1000	Cr. Wh	720	250	2300/4150
1	1000	Whse.	514	250	4000
1	1000	Whse.	720	600	2300/4150
1	1000	Whse.	900	600	2300/4150
1	800	3UGE	1200	240	2300
1	500	G.E.	720	125	2300/4150
1	500	G.E.	720	600	4400
1	750	Whse	720	275	2300/4150
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	4150
1	300	G.E.	1200	120/240	440
1	250	Whse.	1200	240	440
1	150	Cr. Wh.	1200	250	220/440
1	140	Cr. Wh.	720	125/250	2200

ROTARY CONVERTERS (60 cycle)

Qu.	KW	Make	Speed	DC Volts	AC Volts
1	2000	G.E.	514	600	13200
1	2000	G.E.	450	600	13200
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	13200
1	500	Whse.	900	250	6600

All units can be furnished with AC and DC Control

MERCURY ARC RECTIFIERS

1	1000	Al. Chal.	B-612	625	13500
*1	1000	B-B	25/60 cy	625	6600/13200
1	750	G.E.	RHW	575	2300/4000

*Complete with full automatic A.C. and D.C. controls.

A. C. MOTORS—3 Ph. 60 Cycle

Synchronous

Qu.	HP	Make	Type	Volts	Speed
2	3500	G.E.	TS	2300	257
1	2100	G.E.	ATI	4600	514
2	2000	Whse.		2200	120
1	1470	Whse.		2300/4600	900
1	1000	Whse.	MILL	2300	189.5
2	900	Al. Ch	Eng (new)	2200	150
1	600	Whse.		440	360
1	500	G.E.	ATI	480	900
2	500	G.E.	TS-9832	4160	600
1	400	Whse.		2200	128.5
2	350	G.E.	TS	2200	150
1	320	G.E.	ATI	2300	600
1	308	Al. Ch		440	600
1	300	G.E.	ATI	440	720
1	300	Whse.	Exc.	2300	720

Slip Ring

1	1000	Whse.	CW	2300	705
2	700	Whse	CW	2200	900
1	600	G.E.	MT	440	720
1	500	G.E.	IP	550	505
3	450	G.E.	IM	440	505
1	500	G.E.	MIB-IM	2200	450
3	350	Whse.	CW	2200	900
1	350	G.E.	MT-442y	4000/23	257
1	300	Al. Ch.	ANY	2300	505
3	300	Al. Ch.	ANY	2300	705
1	250	G.E.	MT	4000	257
1	250	G.E.	MT-559S	2200	750
1	135	G.E.	IM	2300	705
4	125	G.E.	MT-566Y	2300	435

Squirrel Cage

1	250	G.E.	KT-550	440	1780
1	200	G.E.	KT-557	440	1800
1	200	G.E.	IK	550	585
1	150/50	Whse.	CS	440	720/1443
1	125 (new)	G.E.	KF TEFC	440	1190
1	125	G.E.	KF-6328L	440	3588
2	100	G.E.	KT-543	220/440	1780

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These are GUARANTEED Features

1. New Finish (Buffed and Painted)
2. New or New Appearing Dial Face
3. Jewels and Pivots replaced (normal use of meter, bearings will last 15 yrs.)
4. Register and Top Bearing Friction Removed.
5. Calibration — Accuracy between 99.0% and 101.0% on both Light and Full Load
6. All Meters Checked at 50% Power Factor and at Unity Power Factor
7. HIGH POT—Insulation breakdown tested at 1200 Volts to Ground

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Meters packed for export in steel strapped specially designed meter cartoons, such as manufacturers use, eliminating the expense of wood casing.

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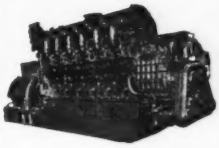

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750 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors
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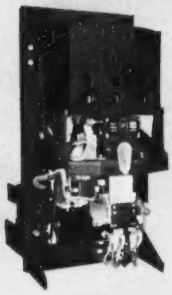
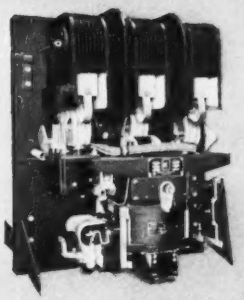
The *extra quality* built into I-T-E Air Breakers



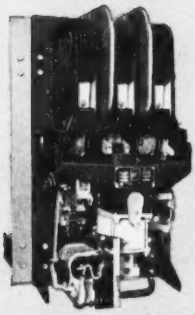
TYPE KA

15,000 RMS Amp. Interrupting Rating. 225 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or electrically operated.



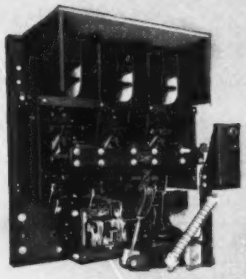
TYPE KC

50,000 RMS Amp. Interrupting Rating. 1600 Amp. Continuous Rating. 2 or 3 Poles. Manually or electrically operated.



TYPE KB

25,000 RMS Amp. Interrupting Rating. 600 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or electrically operated.



TYPE LG

100,000 RMS Amp. Interrupting Rating. 6000 Amp. Continuous Rating. 2, 3, and 4 Poles. Electrically operated.

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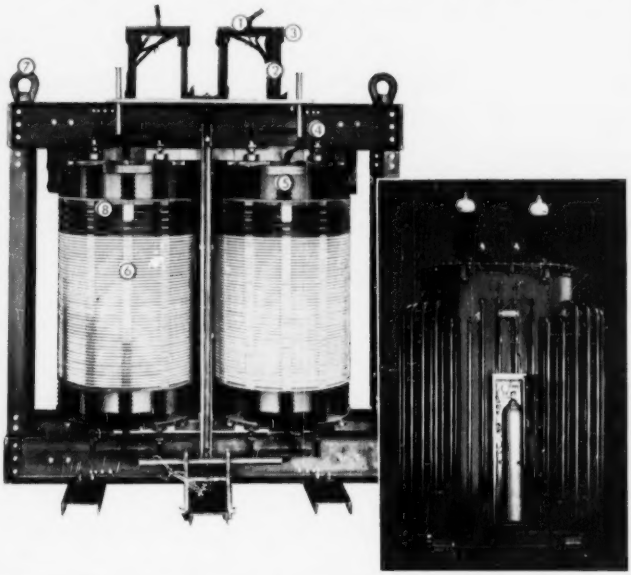
KUHLMAN FACT FILE
POWER TRANSFORMERS

DO YOU BUY TRANSFORMERS BY HABIT OR BY MERIT?

NO. 1 OF A SERIES

KUHLMAN POWER TRANSFORMERS MEET THE MERIT TEST



1	Tap Changer Board — made of special heat resistant material developed by Kuhlman. Won't crack under high Class A insulation temperatures. Increases voltage dielectric strength.	5	Porcelain Blocking Posts—offer increased voltage creepage strength.
2	Terminal Board Supports — manufactured of Grade A press board.	6	Lock Spacers — firmly anchored between coils. Add to over-all construction strength.
3	Fibre Bolts — make top terminal board secure.	7	Handy Lifting Lugs — make any handling job easy.
4	Clamp Jack Screws—supply easily adjustable coil pressure top and bottom.	8	Reinforced End Coils — protect transformer from surge potentials.

It's what is inside a transformer that counts... so take a *revealing look at the inside* of a Kuhlman power transformer. These are only a few of the many features. Others are: solid, carefully constructed connections between coils and extra sturdy bushings to *insure against breakage* due to vibration. Only highest quality oil is used — all transformers are carefully oil vacuum processed. Paint, made to withstand Kuhlman salt spray and weatherometer tests, is *flow-coated on to insure complete coverage.* And according to KVA rating, Kuhlman power transformers may be equipped with sealed tank, inert gas or oil seal method of oil preservation, either pressure or manometer system.

Write today for full information on Kuhlman power transformers ... manufactured through 3750 KVA and 69 KV insulation class.

Kuhlman ELECTRIC COMPANY

BAY CITY, MICHIGAN

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67 BROAD ST., N. Y. CITY 4, N. Y. CABLE ADDRESS, MICROPHONE, N. Y.

TRANSFORMER TOPICS by KUHLMAN

QUESTION:

Two single phase transformers are to be operated in parallel. Characteristics of the two transformers are as follows:

	No. 1	No. 2
Kva	100	200
Voltage	6900/230	6900/230
% IR	1.25	1.34
% I_z	5.49	5.53

(a) At a total load of 300 Kva, 0.8 P.F. lagging, determine the Kva and current supplied by each transformer.

(b) What is the maximum total load at this power factor which will not overload either transformer?

ANSWER:

(a) Constants for Transformer No. 1

$$I = \frac{100 \times 1000}{230} = 435 \text{ amperes.}$$

$$R_1 = \frac{.0125 \times 230}{435} = .00662 \text{ ohms.}$$

$$X_1 = \frac{.0549 \times 230}{435} = .0290 \text{ ohms.}$$

$$Z_1 = .00662 + j\ .0290 = .0296 \text{ ohms.}$$

Constants for Transformer No. 2

$$I = \frac{200 \times 1000}{230} = 870 \text{ amperes.}$$

$$R_2 = \frac{.0134 \times 230}{870} = .00355 \text{ ohms.}$$

$$X_2 = \frac{.0553 \times 230}{870} = 0.0146 \text{ ohms.}$$

$$Z_2 = .00355 + j0.0146 = .0150 \text{ ohms.}$$

$$I_T = \frac{300 \times 1000}{230} = 1310 \text{ amperes.}$$

(Load Current)

Current supplied by Transformer No. 1

$$I_1 = \frac{Z_2}{Z_1 + Z_2} \times I_T = \frac{.0150}{.0296 + .0150} \times 1310 = 440 \text{ amperes}$$

$$KVA_1 = 440 \times 230 \times 10^{-3} = 101.2 \text{ Kva}$$

Current supplied by Transformer No. 2

$$I_2 = \frac{.0296}{.0446} \times 1310 = 870 \text{ amperes}$$

$$KVA_2 = 230 \times 870 \times 10^{-3} = 200 \text{ Kva}$$

(b) $\frac{I_1}{I_2} = \frac{Z_2}{Z_1} = \frac{.0150}{.0296}$

$$\frac{I_2}{I_1} = \frac{.0296}{.0150} = 1.973$$

$$\frac{KVA_1}{KVA_2} = 1.973 \text{ or } KVA_1 = 1.973\ KVA_2$$

$$KVA_1 + KVA_2 = 100 + 200 = 300$$

$$2.973\ KVA_2 = 300$$

$$KVA_2 = 101 \text{ KVA}$$

or practically, the present 300 Kva total load can be carried.